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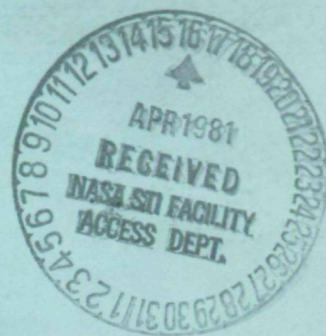
National Aeronautics and  
Space Administration

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# STS-1 First Space Shuttle Mission

Press Kit

April 1981



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FLIGHT SHAKES DOWN SPACE TRANSPORTATION  
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Cover Art: This water color of the Space Shuttle Orbiter Enterprise by Nicholas Solovioff was done as part of NASA's art program through which nationally known artists are invited to document pictorially major NASA activities for an archival history of the exploration of space.

# NASA News

National Aeronautics and  
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RELEASE NO: 81-39

## COLUMBIA'S FIRST FLIGHT SHAKES DOWN SPACE TRANSPORTATION SYSTEM

The Space Shuttle Orbiter Columbia, first in a planned fleet of spacecraft in the nation's Space Transportation System, will liftoff on its first orbital shakedown flight in April 1981. Launch will be no earlier than 45 minutes after sunrise from the NASA Kennedy Space Center Launch Complex 39A.

Crew for the first orbital flight will be John W. Young, commander, veteran of two Gemini and two Apollo space flights, and U.S. Navy Capt. Robert L. Crippen, pilot. Crippen has not flown in space.

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-more-

Columbia will have no payloads in the payload bay on this first orbital flight, but will carry instrumentation for measuring orbiter systems performance in space and during its glide through the atmosphere to a landing after 54 1/2 hours.

Extensive testing of orbiter systems, including the space radiators and other heat rejection systems, fills most of the STS-1 mission timeline. The clamshell-like doors on Columbia's 4.6 by 18-meter (15 by 60-foot) payload bay will be opened and closed twice during the flight for testing door actuators and latch mechanisms in the space environment.

Other tests will measure performance of maneuvering and attitude thrusters, the Columbia's computer array and avionics "black boxes," and, during entry, silica-tile heatshield temperatures.

The first of four engineering test flights, STS-1, will be launched into a 40.3 degree inclination orbit circularized first at 241 kilometers (130 nautical miles) and later boosted to 278 km (150 nm). Columbia will be used in these four test flights in proving the combined booster and orbiter combination before the Space Transportation System becomes operational with STS-5, now forecast for launch in September 1982.

After "tower clear" the launch team in the Kennedy Space Center Firing Room will hand over STS-1 control to flight controllers in the Mission Control Center, Houston, for the remainder of the flight.



Columbia's two orbital maneuvering system hypergolic engines will fire at approximately 53 1/2 hours over the Indian Ocean to bring the spacecraft to a landing on Rogers Dry Lake at Edwards Air Force Base, Calif., an hour later. The approach to landing will cross the California coast near Big Sur at 42,670 m (140,000 ft.) altitude, pass over Bakersfield and Mojave, and end with a sweeping 225-degree left turn onto final approach.

Young and Crippen will land Columbia manually on this first test flight. A microwave landing system on the ground will be the primary landing aid in subsequent flights, with optional manual takeover. Kennedy landing teams will remove the flight crew and "safe" the orbiter after landing.

The first three test flights land on Rogers Dry Lake, the fourth on the main runway at Edwards Air Force Base, and STS-5 will land on the 4,570-m (15,000-ft.) concrete Shuttle Landing Facility runway at Kennedy Space Center.

STS-1 will be the first manned flight using solid rocket boosters. No previous U.S. space vehicle has been manned on its maiden flight.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

Note: Technical descriptions of Orbiter and booster structures and systems are in the Space Shuttle News Reference book mailed to correspondents accredited to cover STS-1. Mission press kits will contain information on payloads, timelines, flight crew and other details peculiar to each flight.

### STS-1 OBJECTIVES: PROVING THE SYSTEM

STS-1 and the three flights following are engineering test flights to prove out the Shuttle system in launch, orbital and landing operations. As the first manned orbital flight, STS-1's flight profile has been designed to minimize structural and operational loads on the spacecraft and its boosters. Orbiter Columbia's cargo bay will be bare for this first test flight except for a data collection and recording package called developmental flight instrumentation (DFI) and an aerodynamic coefficient identification package (ACIP).

The data collection package consists of three magnetic tape recorders, wideband frequency division multiplexers, a pulse code modulation master unit and signal conditioners. The recorders can record 28 tracks of wideband analog data on systems conditions and performance simultaneously. This package will be removed after STS-4 from Columbia's cargo bay, where it is mounted at fuselage station 1069. The aerodynamic package is described under the "Orbital Experiments Program."

A lengthy list of flight test objectives, detailed test objectives and two categories of supplementary objectives spell out what information is sought from STS-1, ranging from thermal responses to systems performance.

The basic STS-1 flight objective is to demonstrate safe launch into orbit and return to landing of Columbia and its crew. Secondly, the flight will verify the combined performance of the entire Shuttle vehicle -- Orbiter, solid rocket boosters, external tank -- up through separation and retrieval of the spent solid rocket boosters. The flight will also gather data on the combined vehicle's aerodynamic and structural responses to the stress of launch. At mission end, similar data will be gathered on Orbiter energy characteristics, such as crossrange steering capabilities, structural loads on entry, and performance of silica-tile thermal protection system.

A major portion of the flight and detailed test objectives is aimed toward wringing out Orbiter hardware systems and their operating computer software, and toward measuring the overall Orbiter thermal response while in orbit with payload doors opened and closed. Still other test objectives evaluate Orbiter's attitude and maneuvering thruster systems and the spacecraft's guidance and navigation system performance.

### ORBITER EXPERIMENTS PROGRAM

A complete and accurate assessment of Shuttle performance during the launch, boost, orbit, atmospheric entry and landing phases of a mission requires precise data collection to document the Shuttle's response to these conditions.

The Office of Aeronautics and Space Technology, through its Orbiter Experiments Program, is providing research-dedicated experiments on board the Shuttle Orbiter to record specific, research-quality data. This data will be used to verify the accuracy of wind tunnel and other ground-based simulations made prior to flight; to verify ground-to-flight extrapolation methods; and to verify theoretical computational methods. The data will also be useful to the Office of Space Transportation Systems in their efforts to further certify the Shuttle and expand its operational envelope.

The prime objective of these experiments is to increase the technology reservoir for development of future (21st century) space transportation systems such as single-stage-to-orbit, heavy-lift launch vehicles and orbital transfer vehicles that could deploy and service large, automated, man-tended, multi-functional satellite platforms and a manned, permanent facility in Earth orbit.

The Orbiter Experiments Program experiments include:

- ACIP - Aerodynamic Coefficient Identification Package;
- SEADS - Shuttle Entry Air Data System;
- SUMS - Shuttle Upper Atmospheric Mass Spectrometer;
- TFI - Technology Flight Instrumentation;
- DATE - Dynamic, Acoustic and Thermal Environment Experiment;
- IRIS - Infrared Imagery of Shuttle;
- SILTS - Shuttle Infrared Leeside Temperature Sensing;
- TGH - Tile Gap Heating Effects Experiment;
- CSE - Catalytic Surface Effects.

Aerodynamic Coefficient Identification Package and Infrared Imagery of Shuttle are the experiments which will obtain data during the STS-1 mission.

#### ACIP - Aerodynamic Coefficient Identification Package

The Shuttle Orbiter presents an unprecedented and continuing opportunity to obtain full-scale flight data for an aircraft-type reentry vehicle throughout the complete aerodynamic regime.

The primary objectives of ACIP are:

- To collect aerodynamic data during the launch, entry and landing phases of the Shuttle;

- To establish an extensive aerodynamic data base for verification of and correlation with ground-based test data, including assessments of the uncertainties in such data;
- To provide flight dynamics data in support of other technology areas, such as aerothermal and structural dynamics.

The Aerodynamic Coefficient Identification Package incorporates three triads of instruments: one of dual-range linear accelerometers; one of angular accelerometers; and one of rate gyros. Also included in this package are the power conditioner for the gyros, the power control systems and the housekeeping components. The package will be installed colinearly with the geometric axes of the Orbiter and post-installation measurements will be made to establish the position within 10 arc minutes. The instruments continuously sense the dynamic X, Y and Z attitudes and performance characteristics of the Orbiter through these critical flight phases. In addition, the package receives Orbiter control surface position data and converts these into higher orders of precision before recording them with the attitude data. Aerodynamic Coefficient Identification Package Principal Technologist is D. B. Howes, Johnson Space Center.

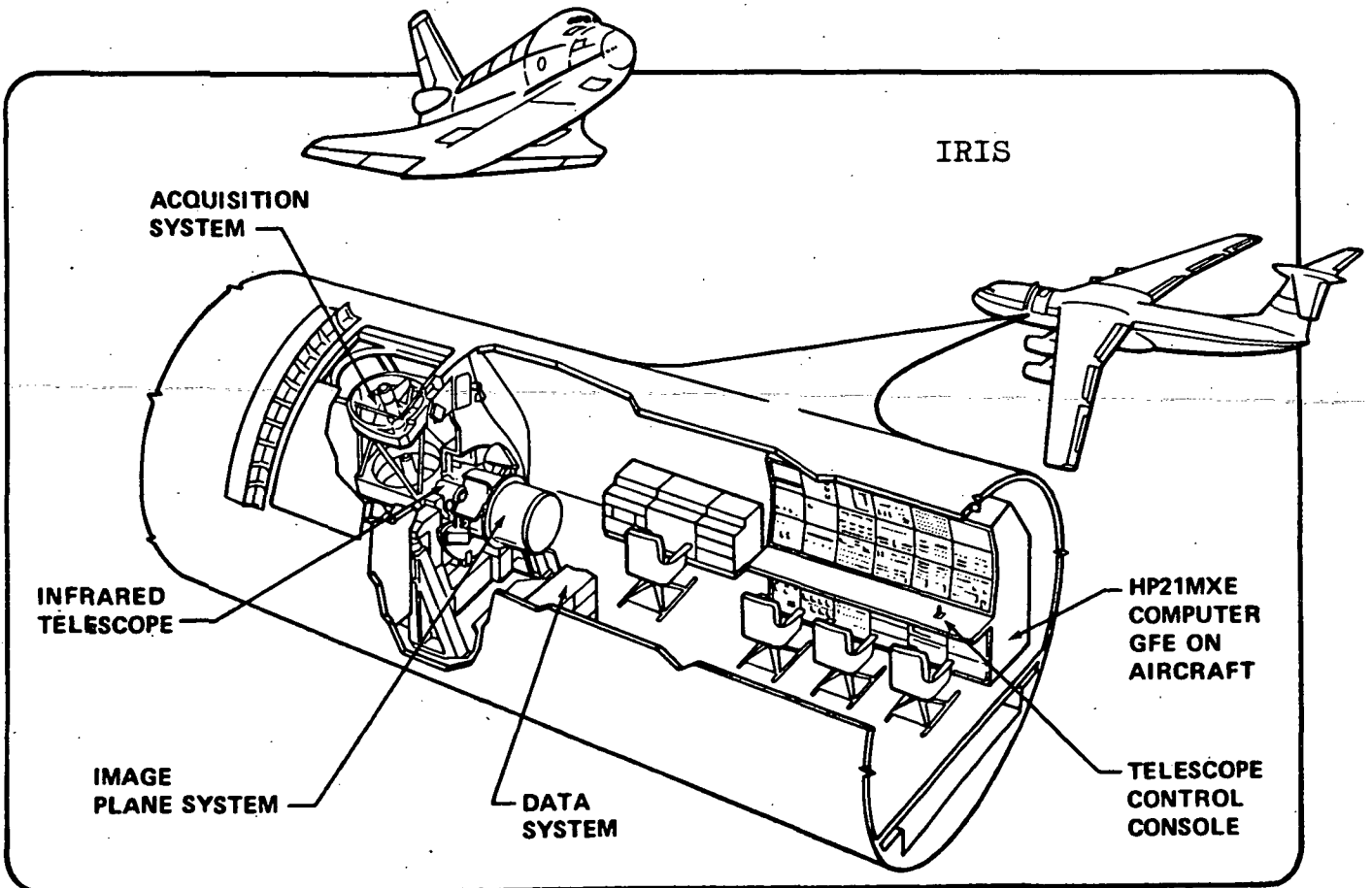
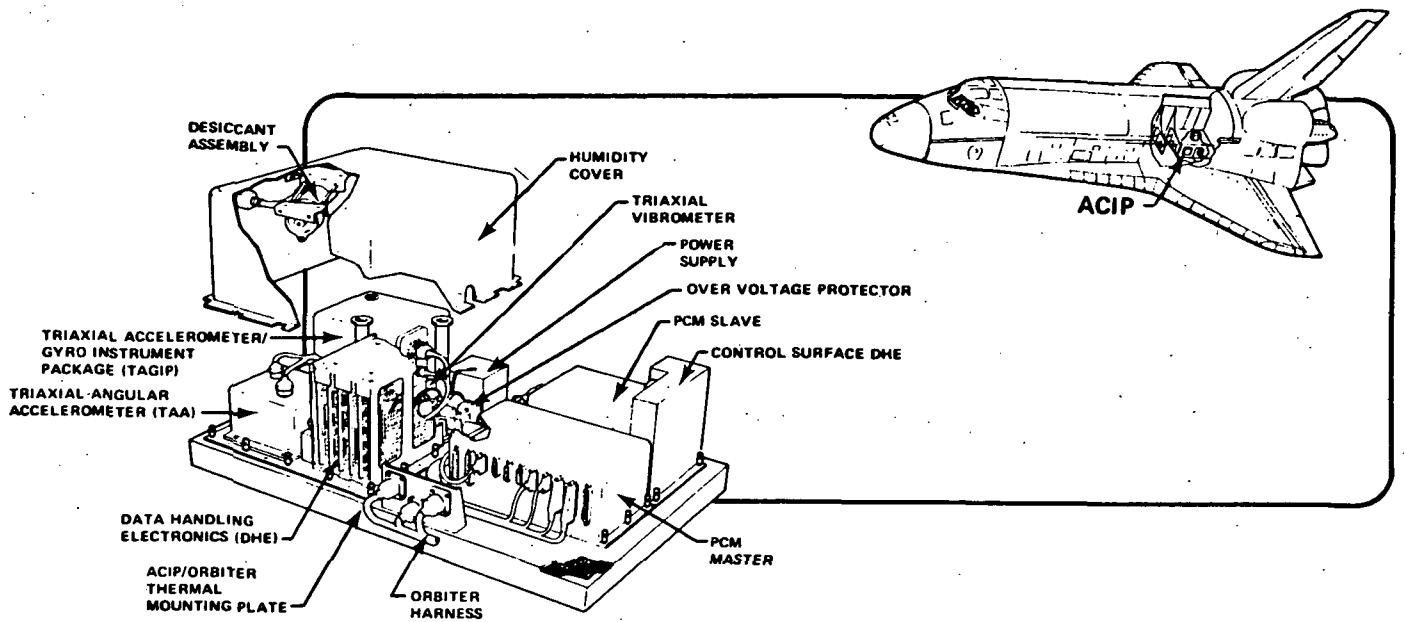
#### IRIS - Infrared Imagery of Shuttle

The objective is to obtain high-resolution infrared imagery of the Orbiter lower (windward) and side surfaces during entry from which surface temperatures and hence aerodynamic heating may be inferred. The imagery will be obtained using a 91.5 centimeter (36-inch) telescope mounted in the NASA C-141 Gerald P. Kuiper Airborne Observatory positioned appropriately at an altitude of 13,716 m (45,000 ft.) along the entry ground track of the Orbiter. A single image will be obtained during each flight.

The primary technology objective is to decrease the current level of uncertainty associated with various entry aerothermodynamic phenomena that affect the thermal protection system design. The phenomena include boundary layer transition, flow separation and reattachment, flow/surface interactions, and surface catalyses to flow chemistry. These data will provide for improved computational procedures and lead to the development of advanced thermal protection systems.

The Infrared Imagery of Shuttle system consists of the C-141 aircraft and its optical system, a 6-cm (2.36-in.) aperture acquisition telescope focal plane system with detector array, and a high-speed data handling and storage system. To conduct the observations, the aircraft will operate from Hickam Air Force Base, Hawaii. The aircraft will be stationed along the Orbiter entry ground track about one hour prior to reentry. As the Orbiter passes through the field of view of the telescope, the Orbiter windward or side surface will be observed by the detector system and the data recorded on tape.





After the flight, these data will be supplemented by Orbiter-derived data of velocity, altitude, angle-of-attack, yaw and roll conditions existing during the period of observation by the Infrared Imagery of Shuttle.

Analysis of these data involves computer arrangement of data into a two-dimensional image format, radiometric analysis and detailed comparisons of the aerodynamic heating rates with analytical predictions and ground-based experimental data. Infrared Imagery of Shuttle Principal Technologist is B. L. Swenson, Ames Research Center.

#### LAUNCH PREPARATIONS, COUNTDOWN AND LIFTOFF

Assembly of the Space Shuttle "stack" for the STS-1 mission began in December 1979, and January 1980, with the erection of the twin solid rocket boosters on a mobile launcher platform in the Kennedy Space Center Vehicle Assembly Building's High Bay 3.

The Space Shuttle Orbiter Columbia arrived at Kennedy Space Center from Dryden Flight Research Center in California aboard the 747 Shuttle Carrier Aircraft on March 24, 1979, and was immediately moved into the Orbiter Processing Facility for systems checkout and the completion of installing its thermal protection system.

The external tank arrived at Kennedy by barge from the Michoud Assembly Facility in New Orleans, La., in July 1979, and underwent processing in the Vehicle Assembly Building's High Bay 4.

The tank was mated with the solid rocket boosters on the mobile launcher platform in early November 1980.

The Columbia was moved from the Orbiter Processing Facility on Nov. 24, 1980, to the adjacent Vehicle Assembly Building where it was mated with the external tank and solid rocket boosters to complete the space vehicle for the STS-1 mission.

The Shuttle Interface Test was conducted in the Vehicle Assembly Building in December to checkout the mechanical and electrical connections between the various elements and the functioning of onboard flight systems.

The assembled Space Shuttle aboard its mobile launcher platform was moved the 5.6 km (3.5 mi.) from the Vehicle Assembly Building to Pad A on Dec. 29, 1980, to undergo final processing for launch.

Pad/flight vehicle interfaces were validated during January and a further series of tests led to the wet (or fueled) Countdown Demonstration Test which culminated in the successful 20-second Flight Readiness Firing of Columbia's three main engines on Feb. 20, 1981.

Upon the conclusion of the readiness firing, steps were taken to repair a small portion of the external tank's super light ablator insulation which became debonded during a tanking test of the Orbiter's supercold liquid oxygen and liquid hydrogen propellants in January.

Major tests conducted during March included the Launch Readiness Verification runs in which flight and landing events were simulated and a "dry" Countdown Demonstration Test. The latter test was a dress rehearsal for launch in which prime crew astronauts John Young and Bob Crippen went through a countdown and simulated liftoff. The dry demonstration test differed from the wet one in that the Shuttle's external tank was not loaded with the Orbiter's liquid hydrogen and liquid oxygen propellants and did not include a test firing of the Orbiter's engines.

The completion of the dry Countdown Demonstration Test and other major tests cleared the way for countdown and launch.

The countdown for the STS-1 mission will be conducted in Firing Room 1 of the Complex 39 Launch Control Center by a government/industry launch team of about 200.

The STS-1 pre-count will be picked up at the T-73-hour mark and includes a number of built-in holds. The hypergolic propellants for the Orbiter's orbital maneuvering and reaction control systems were loaded aboard prior to the wet Countdown Demonstration Test/Flight Readiness Firing. They were not de-tanked after the test and it will not be necessary to service these systems during the countdown.

The hydrazine-fueled auxiliary power units aboard Columbia and the solid rocket boosters' hydraulic power units will be serviced prior to the beginning of the STS-1 pre-count.

Among the early pre-count activities are powering up the Shuttle vehicle, pressurizing the Orbital Maneuvering System and Reaction Control System propellant tanks, software loading of the Orbiter's general purpose computer's mass memory units, battery connections and range safety checks and servicing the fuel cells with liquid oxygen and liquid hydrogen.

Among the major functions in the launch countdown are:

| <u>Count Time</u> | <u>Functions</u>   |
|-------------------|--|
| T-15 hours        | Retract external tank intertank access arm.  |
| T-14 hrs          | Start retraction of rotating service structure. Task completed by T-12 hours.  |
| T-8 hrs           | Lower vent hood (beanie cap) of external tank gaseous oxygen vent over nose cone of external tank.   |
| T-7 hrs           | Start clearing pad for countdown. Clearing completed by T-5 hours.   |
| T-5 hrs           | Begin countdown.   |
| T-4 hrs, 30 min   | Begin chilldown of liquid oxygen transfer system.  |
| T-4 hrs, 20 min   | Begin chilldown of liquid hydrogen transfer system. Begin liquid oxygen fill of external tank.   |
| T-4 hrs, 10 min   | Begin liquid hydrogen fill of external tank.   |
| T-2 hrs, 15 min   | Wake up flight crew.   |
| T-2 hrs, 4 min    | Two-hour built-in hold. External tank loading complete. External tank ice inspection and evaluation will be performed during this hold. Crew will also leave Operations and Checkout Building for pad during hold. |
| T-1 hr, 50 min    | Crew entry begins.   |
| T-1 hr, 25 min    | Crew entry complete.   |
| T-20 min          | 20-minute built-in hold.   |
| T-9 min           | 10-minute built-in hold.   |
| T-9 min           | Go for launch. Start launch processing system ground launch sequencer (automatic sequence).  |
| T-7 min, 5 sec    | Start Orbiter access arm retraction (Fixed Service Structure). Retraction completed by T-4 min, 55 sec.  |
| T-5 min           | Start Orbiter auxiliary power units.   |
| T-3 min, 45 sec   | Run Orbiter aero surfaces profile.   |



|                 |  |
|-----------------|--|
| T-3 min, 30 sec | Orbiter placed on internal power.  |
| T-3 min, 10 sec | Run gimbal slew profile, Space Shuttle main engines.   |
| T-2 min, 55 sec | External tank liquid oxygen to flight pressure.  |
| T-2 min, 50 sec | Start retraction of external tank gaseous oxygen vent arm.   |
| T-1 min, 57 sec | External tank liquid hydrogen to flight pressure.  |
| T-25 sec        | Solid rocket booster hydraulic power units activated. Orbiter onboard general purpose computer assumes control of terminal countdown. Ground launch sequencer remains on line supporting and monitoring launch commit criteria redlines. |
| T-18 sec        | Verify solid rocket booster nozzle positions.  |
| T-11 sec        | Initiate pre-liftoff sound suppression system water.   |
| T-3.8 sec       | .Main engine start sequence command.   |
| T+.24 sec       | All engines at 90 percent thrust.  |
| T+2.88 sec      | External tank umbilical retracted. Solid rocket boosters are ignited and holddown posts are released. Post-liftoff sound suppression water ("rainbirds") initiated.  |
| T-0             | LIFTOFF (Mission elapsed time begins with liftoff.)  |

PROFILE TO ORBIT

STS-1 will be launched from Pad A at the Kennedy Space Center's Launch Complex 39 no earlier than the week of April 5, 1981. Launch windows open at local sunrise plus 45 minutes and are more than 6 hours in duration.

Among the key considerations in establishing the launch windows are lighting conditions which will permit engineering photographic documentation at the launch site, provide adequate lighting for a landing at the Northrup Strip at the White Sands Missile Range, N.M., in the event of an Abort Once Around, and provide for adequate lighting for a landing at the end of the nominal mission at the Dryden Flight Research Center, Edwards Air Force Base, Calif.

Windows for the week of April 5, which are about one minute earlier each day, are as follows:

| <u>Window Open (EST)</u> |      | <u>Duration (Hours)</u> |
|--------------------------|------|-------------------------|
| April 5                  | 0653 | 6.5                     |
| April 6                  | 0652 | 6.6                     |
| April 7                  | 0651 | 6.6                     |
| April 8                  | 0650 | 6.6                     |
| April 9                  | 0649 | 6.6                     |

STS-1 will be launched on a relative flight azimuth varying from 58 to 66 degrees east of north between liftoff, solid rocket booster jettison and main engine cutoff. The orbit at Space Shuttle main engine cutoff will have a relative azimuth (heading) of 66 degrees east of north and be inclined 40.3 degrees to the equator.

The accompanying graph illustrates the time, altitude, relative velocity and downrange distance for the major events in the flight ascent profile. The solid rocket boosters, jettisoned 2 minutes, 12 seconds, after liftoff will impact in the Atlantic Ocean 5 minutes, 11 seconds, after separation at a downrange distance of approximately 256 km (160 mi.).

The external tank jettisoned 8 minutes, 50 seconds, after liftoff will be on a suborbital trajectory that results in an impact location in the Indian Ocean.

# SPACE SHUTTLE LAUNCH EVENTS

| Event                                | Time |     | Altitude |     | Relative Velocity |     | Range |     |
|--------------------------------------|------|-----|----------|-----|-------------------|-----|-------|-----|
|                                      | min  | sec | km       | mi. | km/hr             | mph | km    | mi. |
| SSME ignition                        | -    | 0   | 3.46     |     |                   |     |       |     |
| SSMEs at 90 percent thrust           | +    | 0   | .24      |     |                   |     |       |     |
| SRB ignition/holdown bolts triggered | +    | 0   | 2.64     |     |                   |     |       |     |
| LIFTOFF (see note)                   | 0    | 0   |          |     |                   |     |       |     |
| Clear tower                          | +    | 6   |          |     |                   |     |       |     |
| Begin pitchover                      | 8    |     |          |     |                   |     |       |     |
| SRB separation                       | 2    | 12  |          |     |                   |     |       |     |
| Main engine cutoff                   | 8    | 32  |          |     |                   |     |       |     |
| External tank jettisoned             | 8    | 51  |          |     |                   |     |       |     |

NOTE: Clock for Mission Elapsed Time reverts to 0 at liftoff.  
(a - Meters; b - Feet)

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### FLIGHT PROFILE

During the second orbit Columbia's payload bay doors will be opened, and the space radiators will take over the job of dumping systems and metabolic heat into space. Except for lining up for an Orbital Maneuvering System burn or inertial platform alignment, Columbia will spend most of its first flight with her topside and open payload bay doors facing Earth. Much of the engineering data expected from STS-1 are measurements of how well Orbiter thermal loads are handled by the space radiators, flash evaporators and ammonia boiler heat rejection systems.

Young and Crippen will remove their escape pressure suits three and a half hours after launch, and except for a suit donning/doffing checkout early in the second day of flight, will wear the two-piece flight coveralls until again donning pressure suits four hours before entry and landing.

A carry-on food warmer will be used for the first several flights until the Orbiter galley is installed. The STS-1 crew will sleep in their flight deck seats rather than in sleep restraints on the lower deck planned for later flights. Flight plan updates will be uplinked by Mission Control Center, Houston, to a teleprinter aboard Columbia.

In addition to extensive Orbiter systems tests and performance measurements planned for STS-1, Columbia's ability to hold attitude will be tested several times during the flight. Steady attitude control will be essential for operating many planned scientific experiments that require accurate pointing, and for future rendezvous with other space vehicles.

Columbia's payload bay doors will be closed about four hours prior to landing. A 91-meter-per-second (299-feet-per-second) Orbital Maneuvering System retrograde deorbit burn at 2 days, 5 hours, 27 minutes over the Indian Ocean will bring Columbia to a landing an hour later on the hard-packed sand of Rogers Dry Lake at Edwards Air Force Base, Calif. Columbia will touch down at 185 knots (213 mph) with a vertical sink rate of .23 m/s (2.4 fps). Young and Crippen will fly a manually-controlled landing.

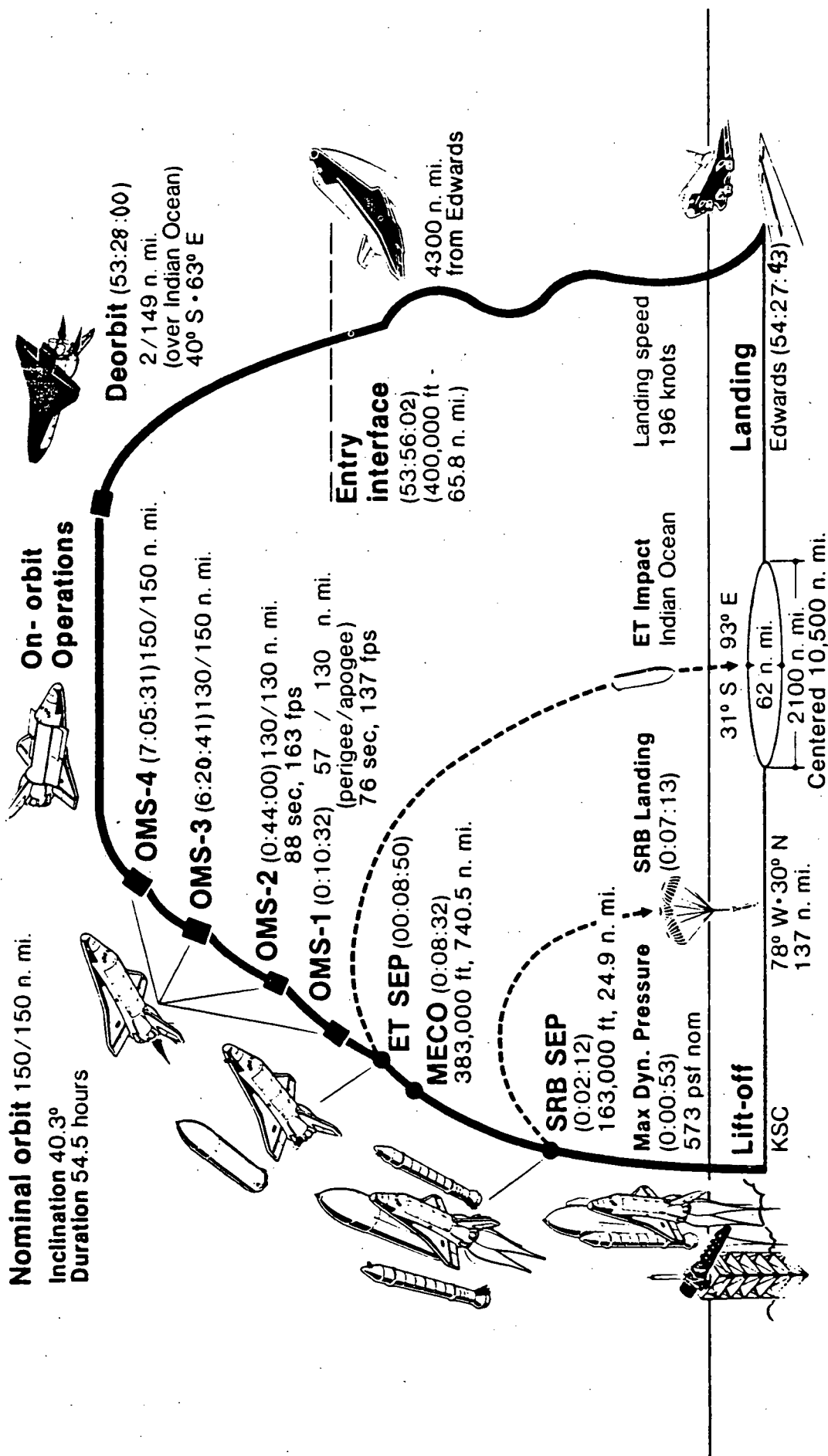
The tables following cover STS-1 flight events and maneuvers and the summary flight plan.

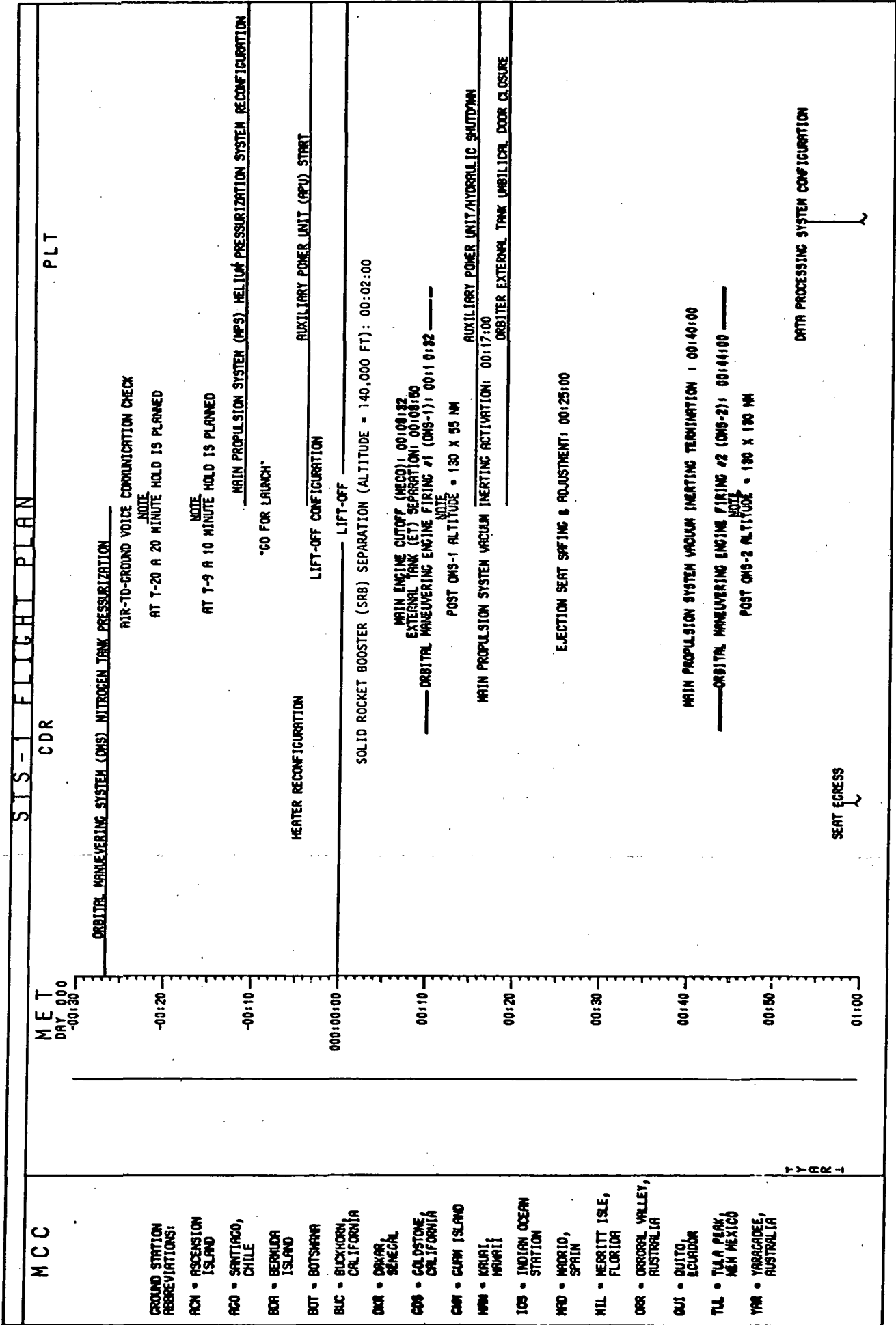


STS-1 FLIGHT SEQUENCE OF EVENTS

| Event                                       | Mission Elapsed Time<br>Hr:Min:Sec | Comments  |
|---|------------------------------------|---|
| SRB Ignition                                | 0:00:00                            |   |
| Liftoff                                     | 0:00:00.3                          |   |
| Pitchover                                   | 0:00:08                            |   |
| Max Q                                       | 0:00:53                            |   |
| SRB Separation                              | 0:02:12                            |   |
| MECO  | 0:08:32                            | Orbit = 13/80 N. Mi.                              |
| ET Separation                               | 0:08:50                            |   |
| OMS-1 Ignition                              | 0:10:32                            | } $\Delta V$ = 165 FPS<br>Orbit = 57/130 N. Mi.   |
| OMS-1 Cutoff                                | 0:12:01                            |   |
| OMS-2 Ignition                              | 0:44:00                            | } $\Delta V$ = 137 FPS<br>Orbit = 130/130 N. Mi.  |
| OMS-2 Cutoff                                | 0:45:15                            |   |
| OMS-3 Ignition                              | 6:20:41                            | } $\Delta V$ = 36.5 FPS<br>Orbit = 130/150 N. Mi. |
| OMS-3 Cutoff                                | 6:21:20                            |   |
| OMS-4 Ignition                              | 7:05:31                            | } $\Delta V$ = 37.5 FPS<br>Orbit = 150/150 N. Mi. |
| OMS-4 Cutoff                                | 7:06:11                            |   |
| Translation Maneuver Test:                  |                                    |   |
| - No. 1                                     | 22:20:00                           | 150/150   |
| - No. 2                                     | 26:22:00                           | 150/150   |
| - No. 3                                     | 29:22:00                           | 150/150   |
| Deorbit Ignition                            | 53:28:00                           | } $\Delta V$ = 299. FPS<br>Orbit = 2/149 N. Mi.   |
| Deorbit Cutoff                              | 53:30:27                           |   |
| Entry Interface                             | 53:56:02                           |   |
| Initiate Terminal<br>Area Energy Management | 54:21:30                           |   |
| Landing                                     | 54:27:43                           |   |

# Space Shuttle Nominal Mission Profile for STS-1





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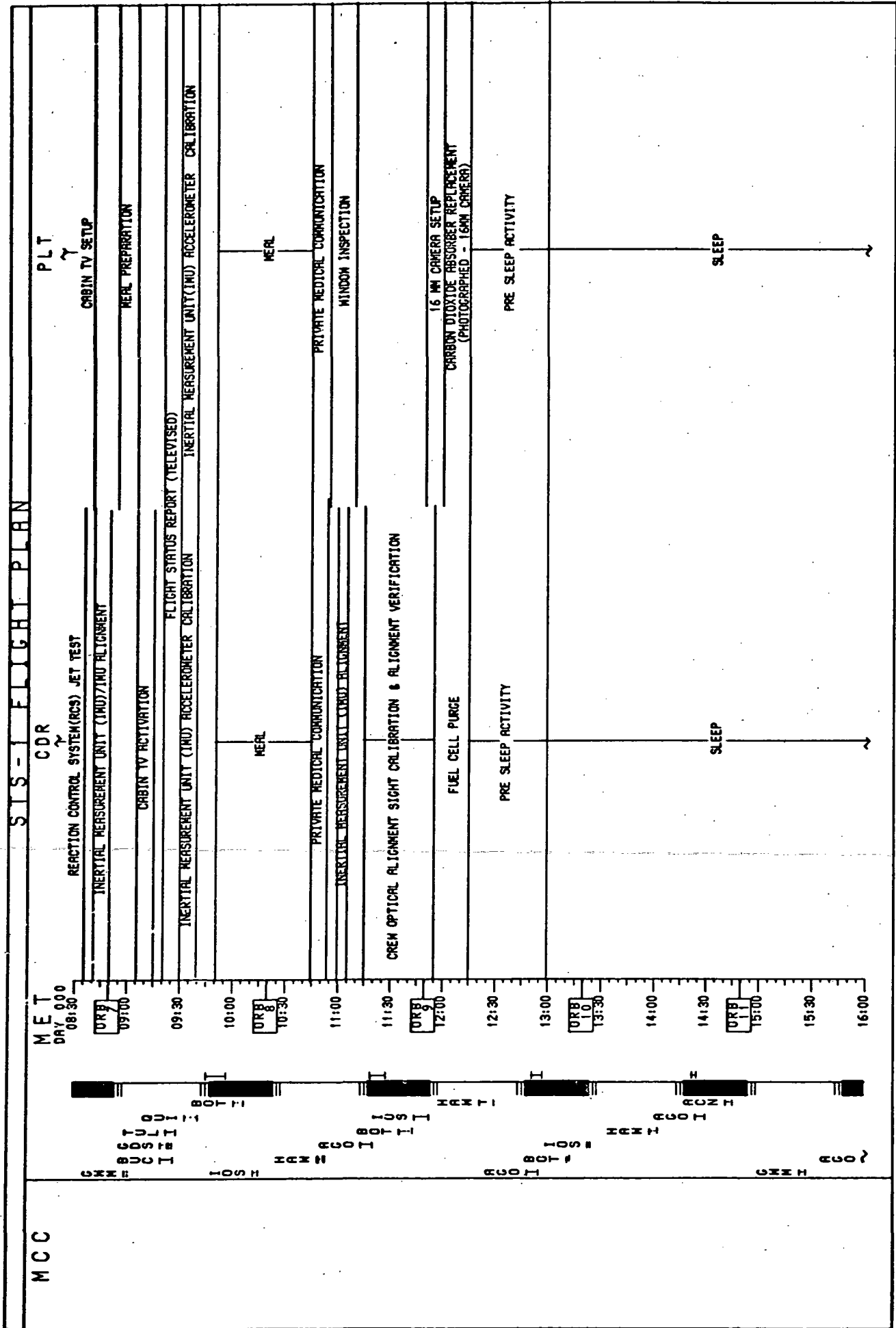
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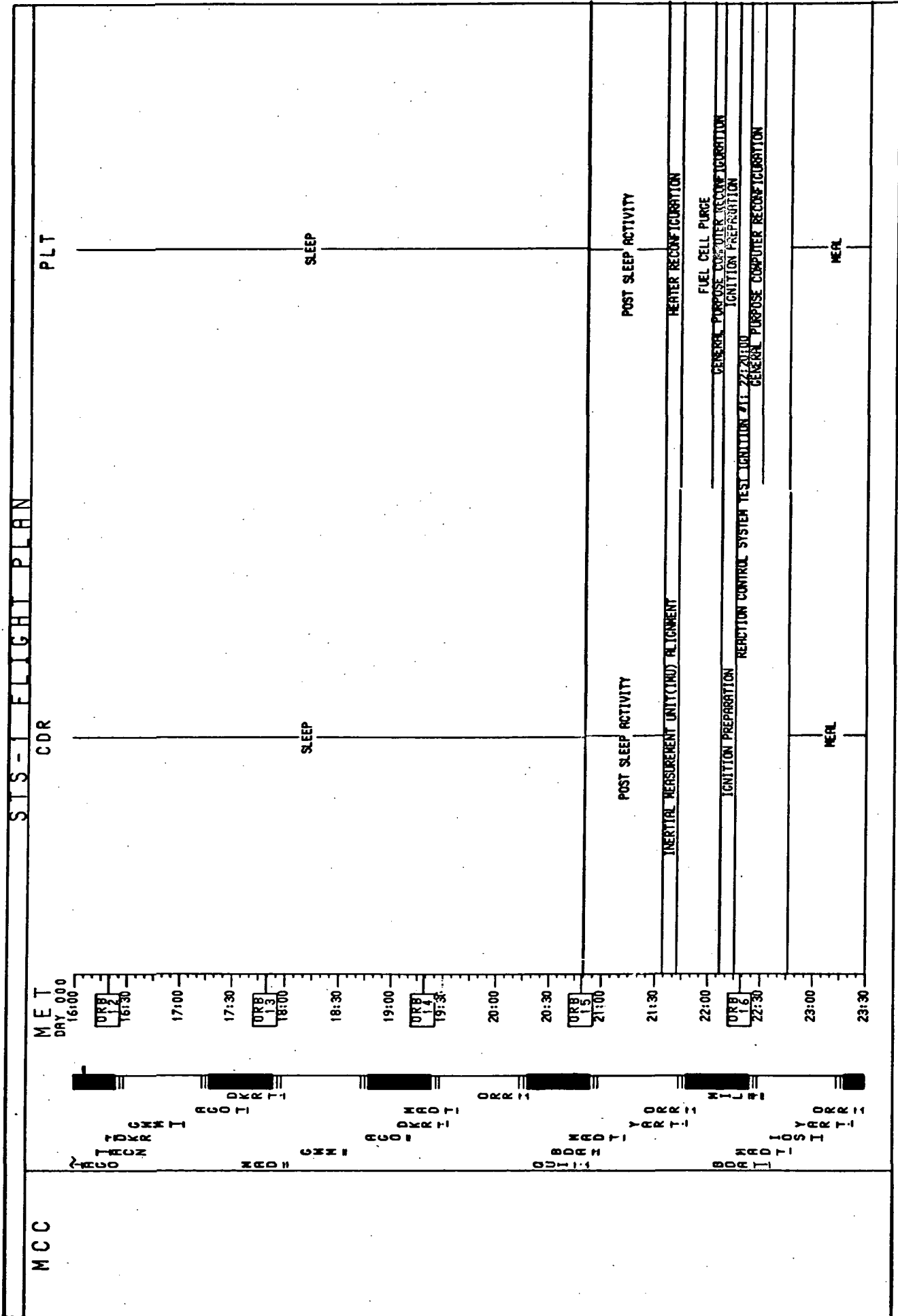
CDR

PLT



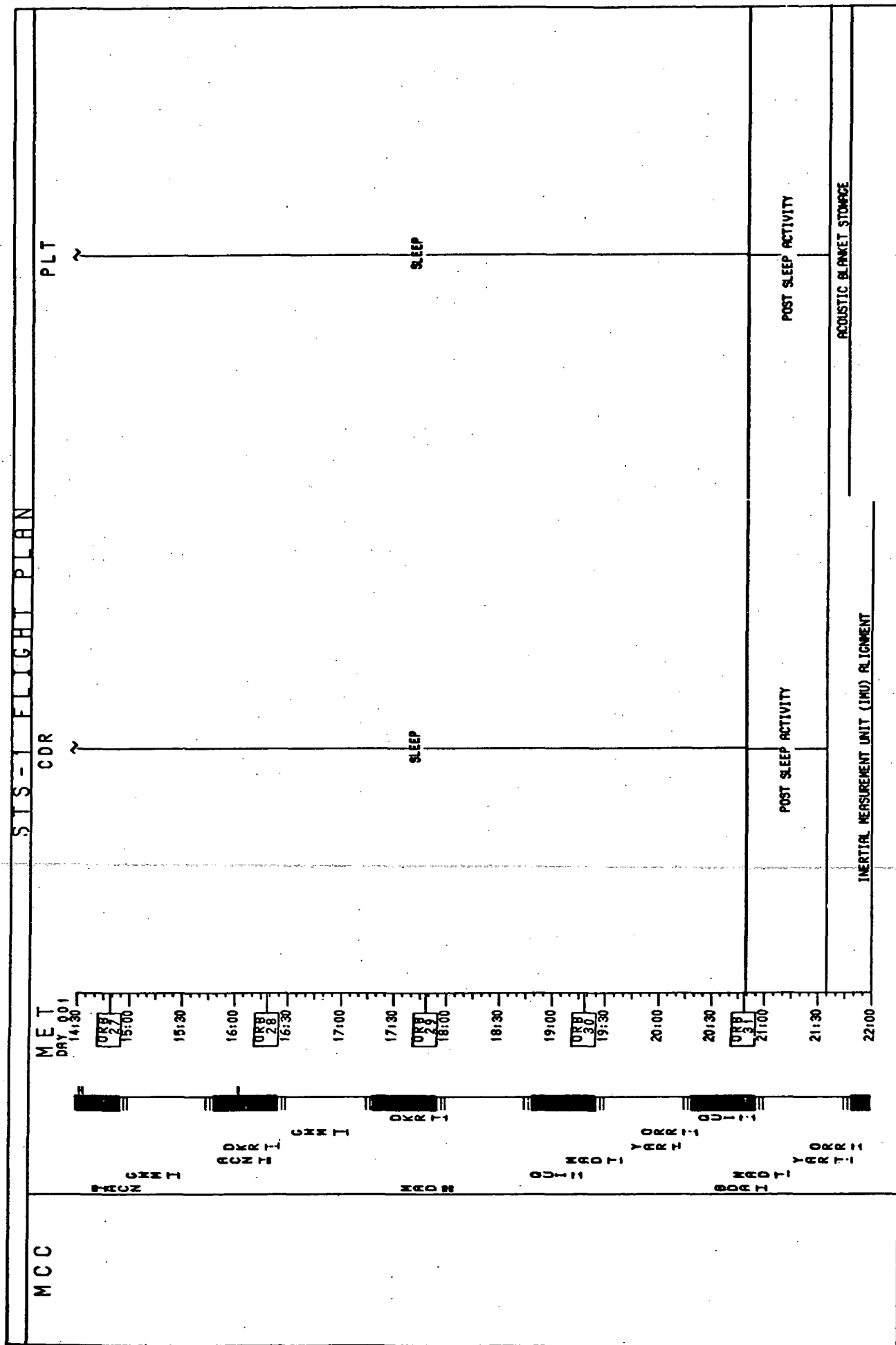




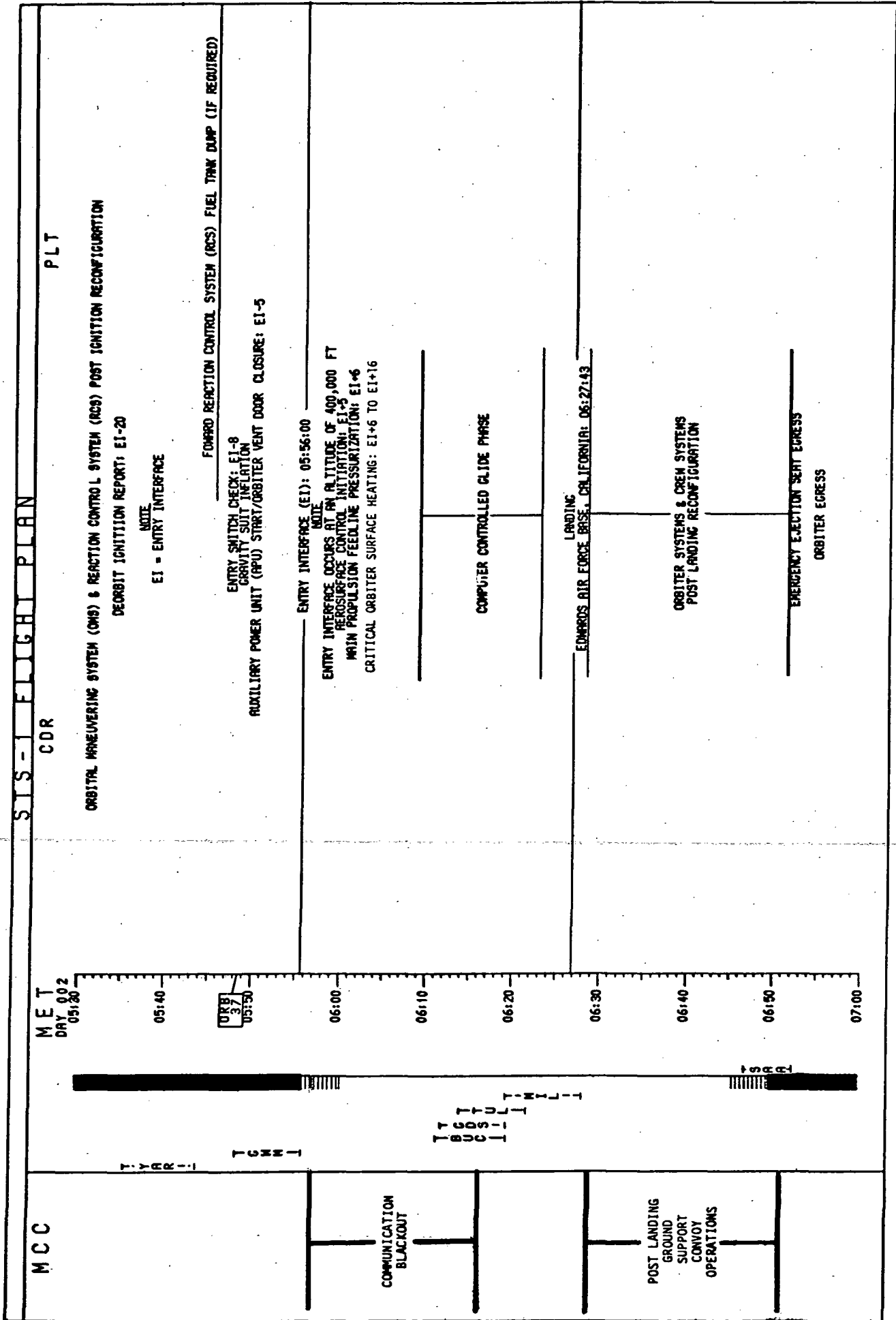


| STS - FLIGHT PLAN |  | MCC  |  |
|-------------------|--|--|--|
| ME T              | CDR  | PLT  |  |
| DAY 000           |  |  |  |
| 23:30             |  |  |  |
| 00:00             | FLIGHT CONTROL SYSTEM CONFIGURATION                | FLIGHT CONTROL SYSTEM CONFIGURATION                |  |
| 00:10             | DATA PROCESSING SYSTEM RECONFIGURATION             | DATA PROCESSING SYSTEM RECONFIGURATION             |  |
| 00:30             | FLIGHT CONTROL SYSTEM CHECKOUT-PART 2 (TELEVIEWED) | FLIGHT CONTROL SYSTEM CHECKOUT-PART 2 (TELEVIEWED) |  |
| 01:00             | DATA PROCESSING SYSTEM RECONFIGURATION             | DATA PROCESSING SYSTEM RECONFIGURATION             |  |
| 01:30             | FLIGHT CONTROL SYSTEM RECONFIGURATION              | FLIGHT CONTROL SYSTEM RECONFIGURATION              |  |
| 02:00             | CLOSED CIRCUIT TV CHECKOUT (WITH ARTIFICIAL LIGHT) |  |  |
| 02:30             | IGNITION PREPARATION                               | IGNITION PREPARATION                               |  |
| 03:00             | REACTION CONTROL SYSTEM TEST IGNITION #21 02122100 | REACTION CONTROL SYSTEM TEST IGNITION #21 02122100 |  |
| 03:30             | COOLING RADIATOR BYPASS                            | PAYLOAD BAY DOOR CLOSING                           |  |
| 04:00             | IGNITION PREPARATION                               | IGNITION PREPARATION                               |  |
| 04:30             | REACTION CONTROL SYSTEM TEST IGNITION #31 03122100 | DATA PROCESSING SYSTEM RECONFIGURATION             |  |
| 05:00             | CABIN AIR QUALITY TEST                             | MEAL PREPARATION                                   |  |
| 05:30             |  | MEAL   |  |
| 06:00             | MEAL   | MEAL   |  |
| 06:30             | INERTIAL MEASUREMENT UNIT (IMU) ALIGNMENT          | WINDOW INSPECTION                                  |  |
| 07:00             | EMERGENCY EJECTION SUIT(EES) DOWNING               | CLOSED CIRCUIT TV CHECKOUT (IN SUN LIGHT)          |  |
|                   | EMERGENCY EJECTION SUIT(EES) DOWNING               | EMERGENCY EJECTION SUIT(EES) DOWNING               |  |

| SIS - FLIGHT PLAN |                                 |
|-------------------|---------------------------------|
| MCC               | PLT                             |
| 07:00             | EMERGENCY EJECTION SUIT DOWNING |
| 07:10             | SEAT INGRESS                    |
| 07:20             | SEAT EGRESS                     |
| 07:30             | EMERGENCY EJECTION SUIT DOFFING |
| 08:00             | EMERGENCY EJECTION SUIT DOFFING |
| 08:30             | EMERGENCY EJECTION SUIT DOFFING |
| 09:00             | EMERGENCY EJECTION SUIT DOFFING |
| 09:30             | EMERGENCY EJECTION SUIT DOFFING |
| 10:00             | EMERGENCY EJECTION SUIT DOFFING |
| 10:30             | EMERGENCY EJECTION SUIT DOFFING |
| 11:00             | EMERGENCY EJECTION SUIT DOFFING |
| 11:30             | EMERGENCY EJECTION SUIT DOFFING |
| 12:00             | EMERGENCY EJECTION SUIT DOFFING |
| 12:30             | EMERGENCY EJECTION SUIT DOFFING |
| 13:00             | EMERGENCY EJECTION SUIT DOFFING |
| 13:30             | EMERGENCY EJECTION SUIT DOFFING |
| 14:00             | EMERGENCY EJECTION SUIT DOFFING |
| 14:30             | EMERGENCY EJECTION SUIT DOFFING |



| MCC |  | SIS - FLIGHT PLAN |  | MET     |  | CDR   |  | PLT   |  |
|-----|--|-------------------|--|---------|--|---|--|---|--|
|     |  |                   |  | DAY 001 |  | REACTION CONTROL SYSTEM (RCS) JET TEST                    |  | FUEL CELL PURGE   |  |
|     |  |                   |  | 22:00   |  |   |  |   |  |
|     |  |                   |  | 22:30   |  |   |  |   |  |
|     |  |                   |  | 23:00   |  | MEAL  |  | MEAL  |  |
|     |  |                   |  | 23:30   |  | ENTRY STORAGE   |  | ENTRY STORAGE   |  |
|     |  |                   |  | 00:00   |  | FLIGHT CONTROL SYSTEM (FCS) RECONFIGURATION               |  | FLIGHT CONTROL SYSTEM (FCS) RECONFIGURATION               |  |
|     |  |                   |  | 00:30   |  | DATA PROCESSING SYSTEM RECONFIGURATION                    |  | DATA PROCESSING SYSTEM RECONFIGURATION                    |  |
|     |  |                   |  | 01:00   |  | FLIGHT CONTROL SYSTEM CHECKOUT                            |  | FLIGHT CONTROL SYSTEM CHECKOUT                            |  |
|     |  |                   |  | 01:30   |  | INERTIAL MEASUREMENT UNIT (IMU) ACCELEROMETER CALIBRATION |  | INERTIAL MEASUREMENT UNIT (IMU) ACCELEROMETER CALIBRATION |  |
|     |  |                   |  | 02:00   |  | CREW SYSTEMS DEACTIVATION                                 |  | CREW SYSTEMS DEACTIVATION                                 |  |
|     |  |                   |  | 02:30   |  | EMERGENCY EJECTION SUIT DOWNING                           |  | EMERGENCY EJECTION SUIT DOWNING                           |  |
|     |  |                   |  | 03:00   |  | DATA PROCESSING SYSTEM RECONFIGURATION                    |  | DATA PROCESSING SYSTEM RECONFIGURATION                    |  |
|     |  |                   |  | 03:30   |  | PAYLOAD BAY DOOR CLOSING                                  |  | PAYLOAD BAY DOOR CLOSING                                  |  |
|     |  |                   |  | 04:00   |  | INERTIAL MEASUREMENT UNIT ALIGNMENT/ VERIFICATION         |  | INERTIAL MEASUREMENT UNIT ALIGNMENT/ VERIFICATION         |  |
|     |  |                   |  | 04:30   |  | FORWARD & AFT CABIN SWITCH POSITION VERIFICATION          |  | FORWARD & AFT SWITCH POSITION VERIFICATION                |  |
|     |  |                   |  | 05:00   |  | SEAT INGRESS  |  | SEAT INGRESS  |  |
|     |  |                   |  | 05:30   |  | DEORBIT IGNITION PREPARATION                              |  | DEORBIT IGNITION PREPARATION                              |  |
|     |  |                   |  |         |  | DEORBIT IGNITION: 05:27:52                                |  |   |  |



### LANDING AND POSTLANDING OPERATIONS

Ground operations to prepare the Columbia for a ferry flight to Kennedy Space Center and launch on subsequent missions will begin immediately upon the spacecraft's rollout on the dry lake bed at Edwards Air Force Base, Calif. The Kennedy Space Center is responsible for ground operations and a recovery convoy will move in to begin preliminary securing and safing operations as soon as Columbia has come to a stop. Early tasks consist of establishment of ground communications, the connection and initiation of ground cooling and purge air flow, a post-landing inspection and safety verification and the connection of the ground tow vehicle to the Orbiter. The flight crew will leave the vehicle and be replaced by a ground crew approximately 45 minutes after landing.

The 18-unit ground convoy consists of the elements required to detect and disperse hazardous vapors, service Columbia's systems, transport and support ground personnel wearing protective garments, provide access to the crew compartment and transport the flight crew and ground crew which will replace them, and fire-fighting equipment.

Post-landing operations will be performed in the following sequence:

On the conclusion of Orbiter rollout, the flight crew will safe the Columbia's orbital maneuvering and reaction control system prior to ground crew access.

After this has been done, ground personnel wearing protective garments will move in next to the Orbiter and use sensitive "sniffer" devices to verify the absence of explosive or toxic gases such as ammonia, hydrazine, monomethyl hydrazine or gaseous hydrogen. A mobile wind machine will be used to reduce the possibility that explosive or toxic gases exist in dangerous concentrations.

Then access vehicles will be placed adjacent to the liquid oxygen and liquid hydrogen T-zero umbilicals on the aft end of the Orbiter approximately 7 minutes after landing.

Large transporters bearing purge and cooling ground support units will then be moved into place behind the Orbiter and their lines connected with the appropriate T-zero umbilicals.

The lines from the coolant transporter will be connected with the liquid hydrogen T-zero umbilical on the left side of the Orbiter. Once the connection has been made, Freon from this ground unit will begin flowing through the Orbiter's cooling systems.



The lines from the purge transporter will be connected with the liquid oxygen T-zero umbilical on the right side of the Orbiter. This unit will supply air conditioning for temperature and humidity to the Orbiter's payload bay and other cavities to remove any residual explosive or toxic fumes and provide a safe, clean and cool environment inside the vehicle.

After a further assessment by a safety assessment team, the protective suit requirement will be removed and tow preparations and crew exchange activities will be initiated. The crew module hatch access vehicle will be then positioned adjacent to the crew hatch on the left side of the vehicle.

Following the opening of the hatch, an activity expected to require 18 minutes, the flight and ground crews will be exchanged and the hatch will then be closed. After removing the hatch access vehicle, the tow of the Orbiter to the NASA area at the Dryden Flight Research Center will begin.

The elapsed time from the end of the rollout to the beginning of the tow is approximately one hour.

The Orbiter will be in the Dryden Center's facilities for a week to 10 days undergoing further system deservicing and ferry flight preparations for the journey back to the Kennedy Space Center.

Nominal flight time for the Columbia aboard the 747 Shuttle Carrier Aircraft is two days.

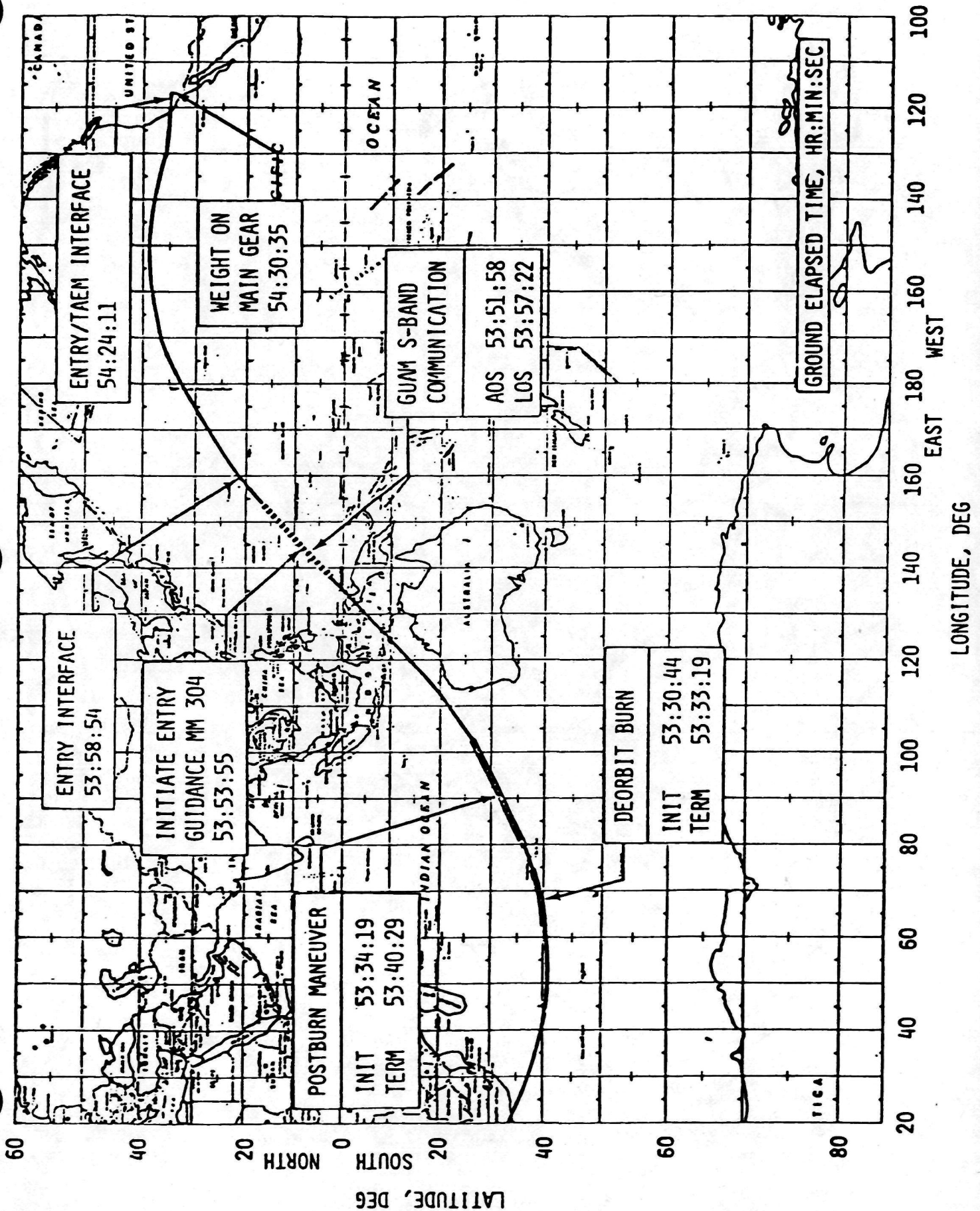
Columbia is due to arrive back at Kennedy from 10 days to two weeks after its touchdown in California from its first orbital mission.

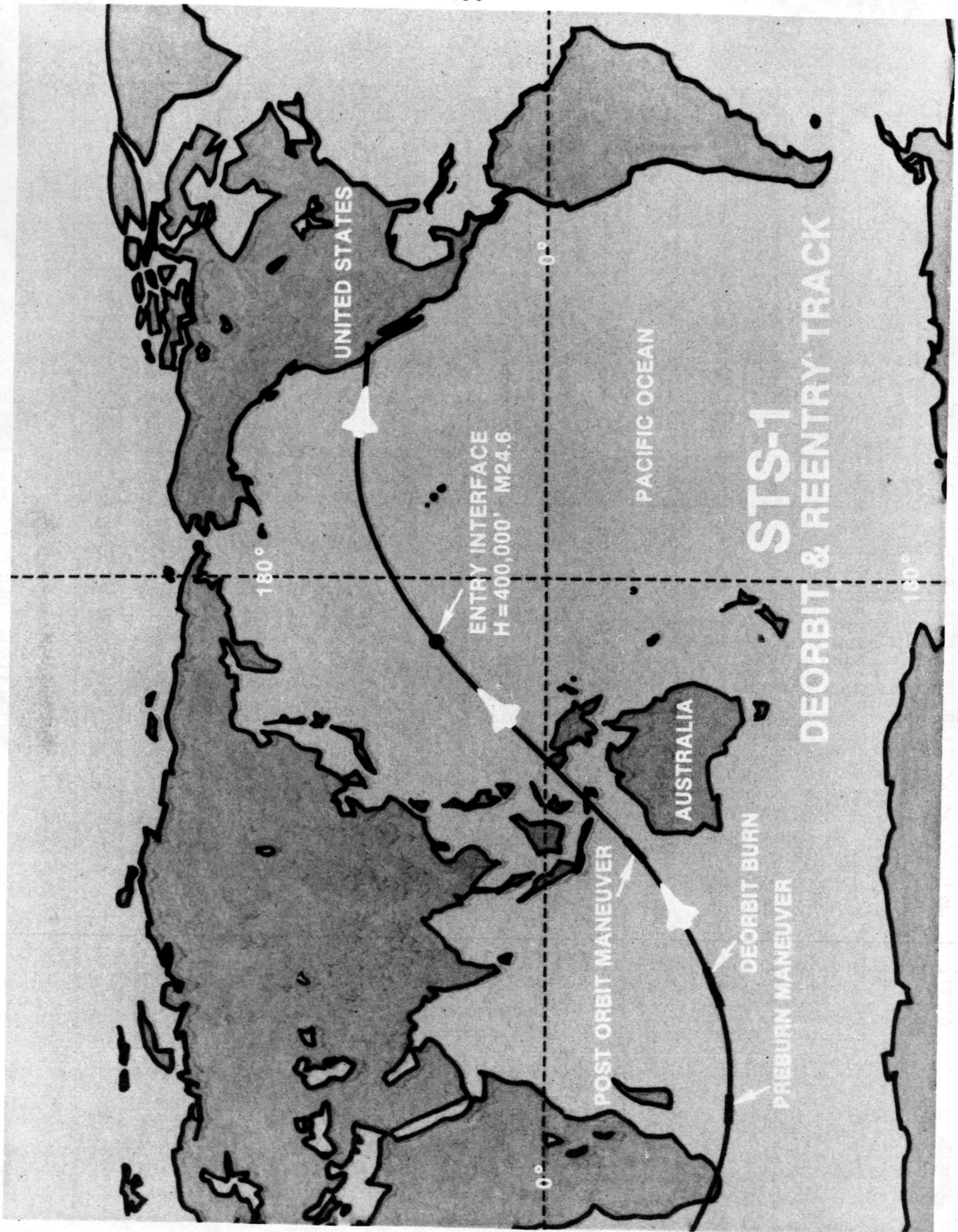
SHUTTLE TRAJECTORY (FINAL)

| <u>Location/Event</u>                             | <u>Speed</u>  | <u>Altitude<br/>(feet)</u> | <u>Time to<br/>Touchdown</u> |
|---|---|----------------------------|------------------------------|
| West edge of lake bed                             | M1.2  | 53,000                     | 270 sec                      |
| East edge of lake bed                             | M0.88   | 44,000                     | 230 sec                      |
| Abeam Boron, heading 330<br>degrees (turn final)  | 270KEAS<br>13,000 fpm<br>descent rate<br>20 degrees<br>glide path | 18,500                     | 110 sec                      |
| Coming across U.S. 58<br>5 1/2 nm on final        | 20 degrees<br>glide path  | 10,000                     | 76 sec                       |
| Initiate preflare 1/3 nm<br>from edge of lake bed | 280KEAS   | 2,000                      | 36 sec                       |
| Gear Down command                                 | 270KEAS<br>5 degrees<br>glide path                                | 250                        | 19 sec                       |
| Gear locked                                       | 230KEAS   | 100                        | 11 sec                       |
| Touchdown   | 180KEAS   | 0                          | 0 sec                        |

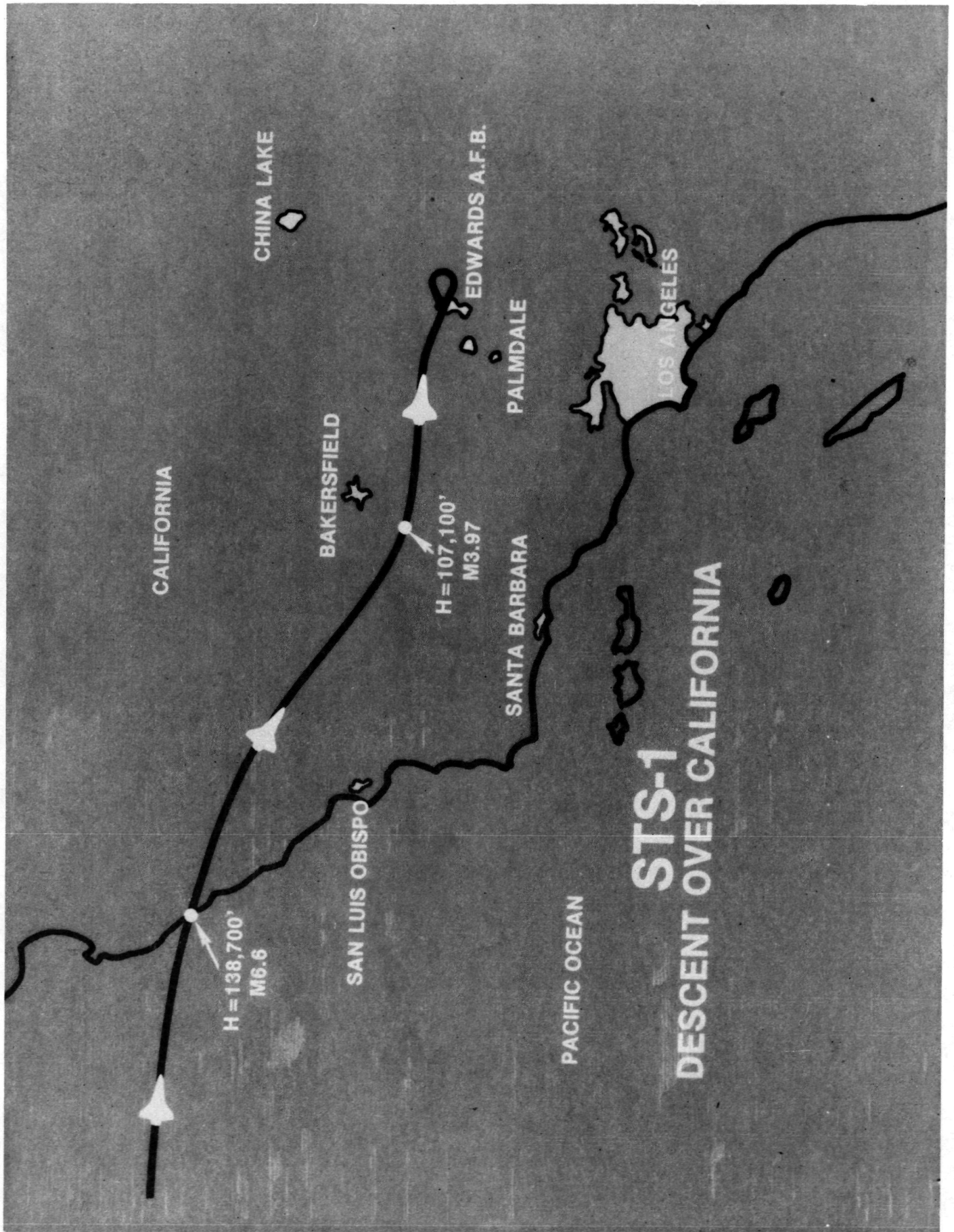
M - Mach

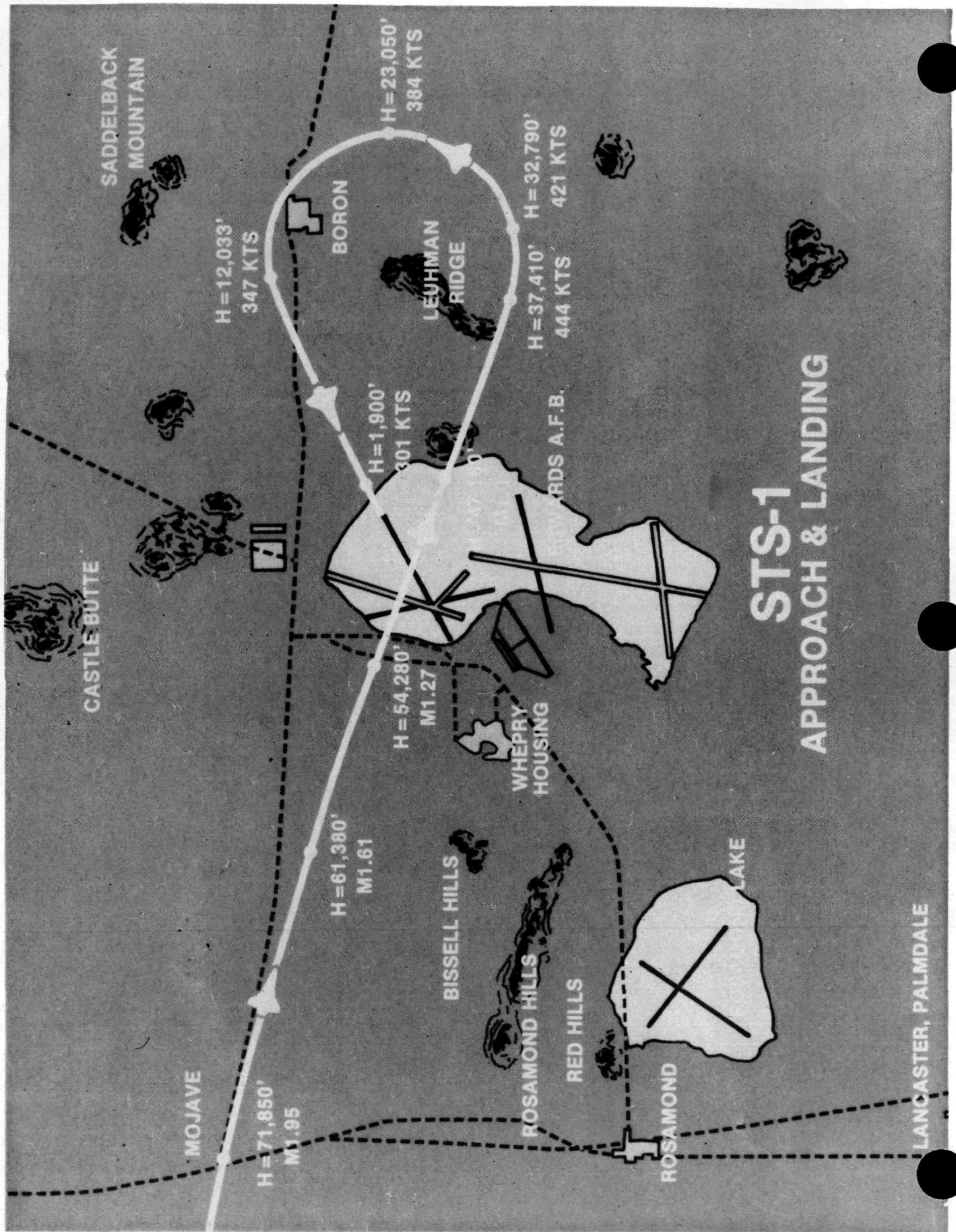
KEAS - Knots Equivalent Air Speed









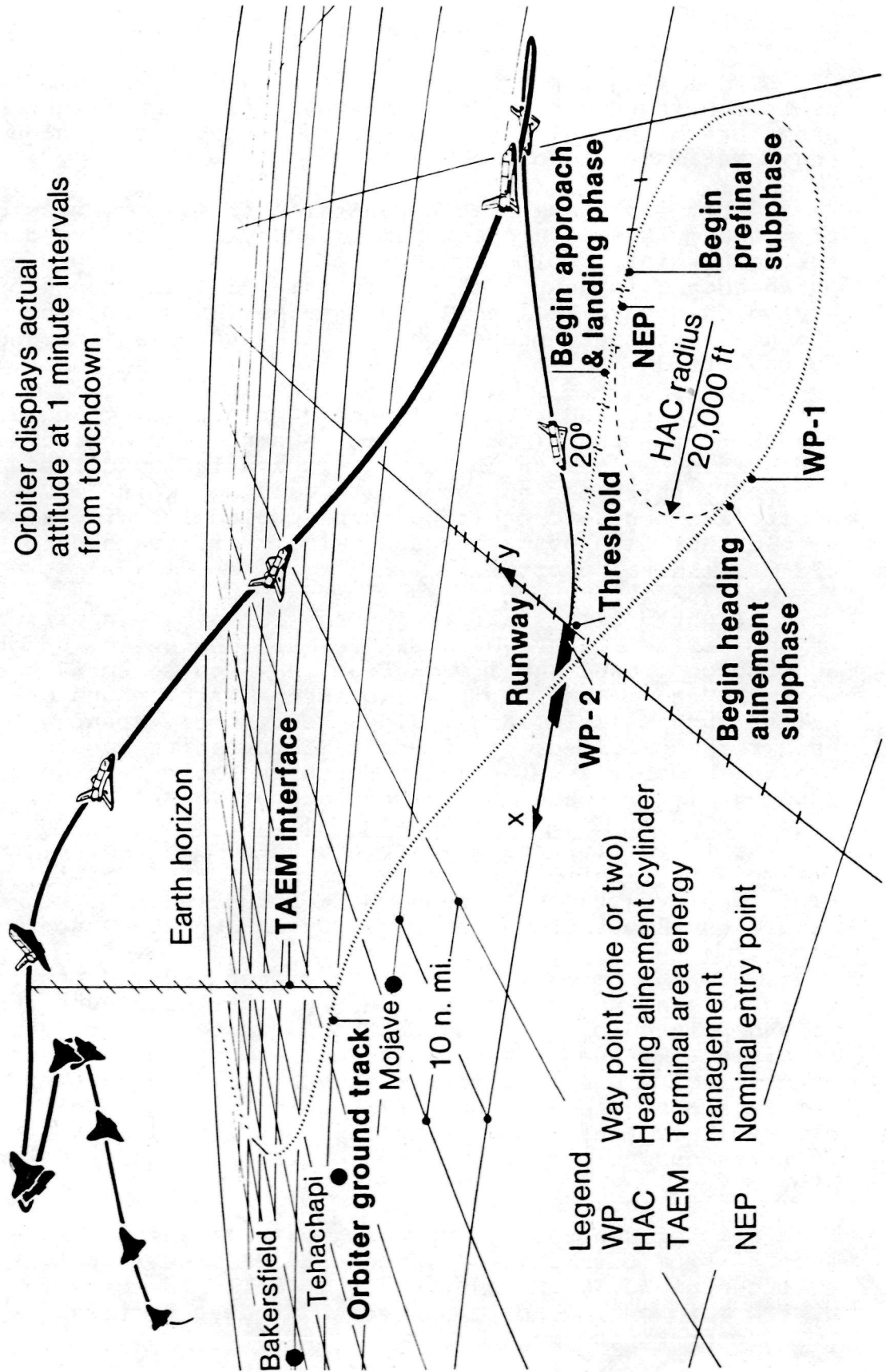




NASA

# STS-1 Entry Flight Profile

Note:  
Orbiter displays actual  
attitude at 1 minute intervals  
from touchdown



IF THINGS DON'T GO RIGHT

(Contingencies)

STS-1 flight planners have attempted to anticipate any possible contingency that could happen during the flight -- from premature main engine shutdown to a sudden desert cloudburst making a wet lake of Rogers Dry Lake.

"What ifs" have been a central part of each mission design from the outset of Project Mercury 20 years ago and continuing through Gemini, Apollo and Skylab. While there were no launch-phase aborts in any of these programs, the cryogenic oxygen tank explosion aboard Apollo 13 and the ensuing use of the lunar module as a lifeboat, proved that contingency planning and training do pay off.

The preferred type of launch abort for Shuttle launches is the abort-to-orbit (ATO) in which enough main engine and orbital maneuvering system engine energy is available to reach a 194-km (105-nm) orbit, but not enough to get the nominal 278-km (150-nm) orbit. An abort-to-orbit would be called for if one main engine should shut down before enough velocity is reached to yield a 278-km (150-nm) orbit.

Slightly less available energy for orbit insertion because of an earlier failure of a single main engine would force an abort-once-around (AOA) situation in which Columbia would land near the end of one orbit at Northrup Strip on the U.S. Army White Sands Missile Range, N.M. Abort-once-around would also be used for any time-critical Orbiter systems failures requiring immediate deorbit and landing. Northrup Strip is also the backup landing site in case Rogers Dry Lake at Edwards is wet.

Still earlier shutdown of a single main engine brings about the more critical return-to-launch-site (RTLS) abort. The vehicle would be turned around while thrusting and then glide back toward the Shuttle Landing Facility at Kennedy Space Center.

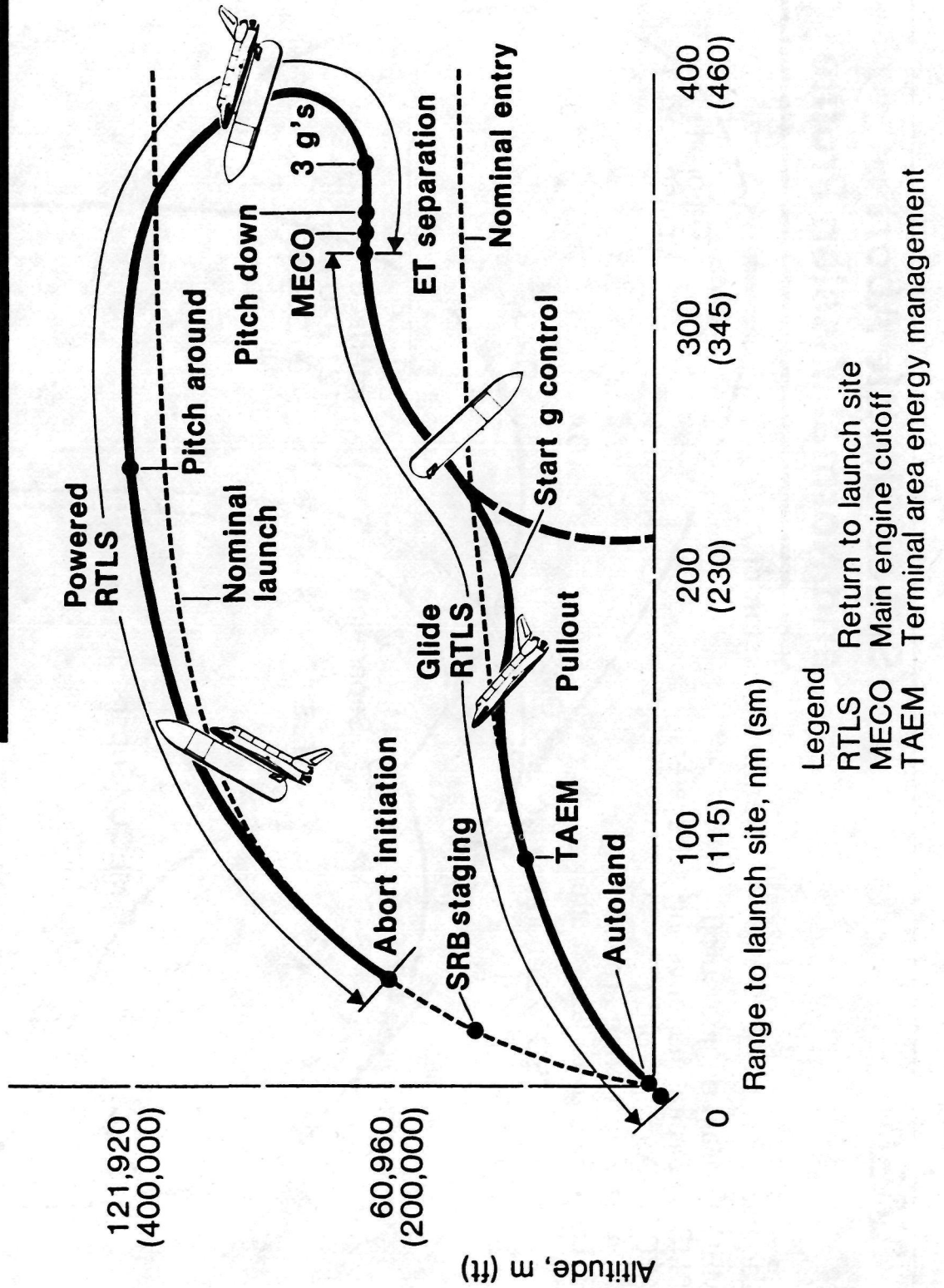
Once the decision to abort had been made, Columbia and the external tank would be flown in a pitch-around maneuver to head-up and pointed back along the ground track to Cape Canaveral. The remaining two functioning main engines would cancel out the eastward velocity and accelerate the vehicle in a westward direction until enough velocity and distance is reached to glide along a normal entry trajectory to the Kennedy runway. Orbiter systems failures during ascent could also force a return-to-launch-site abort.

Loss of control or impending catastrophic failure during ascent, from clearing the launch pad service structure up to an altitude of 30,480 m (100,000 ft.), calls for crew ejection. Loss of two main engines prior to seven minutes of flight would also require crew ejection.



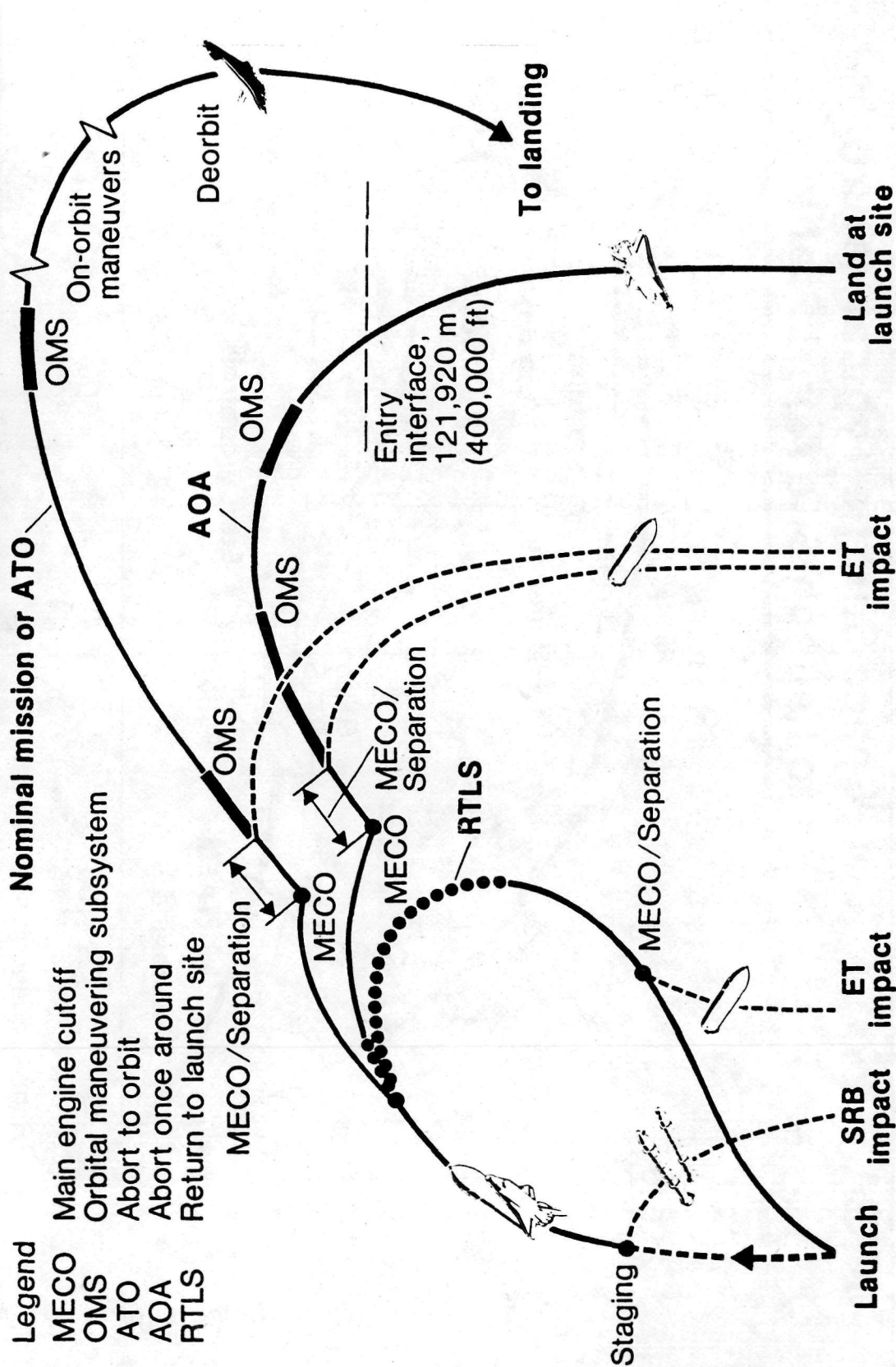
NASA

## Space Shuttle Typical Return to Launch Site Abort Profile



**NASA**

# Space Shuttle Abort and Normal Mission Profile



Shuttle abort philosophy emphasizes safe return of the flight crew, the Orbiter and its payloads to an intact landing at either the prime landing site at Edwards, the backup site at White Sands, or the contingency landing sites at Hickam Air Force Base, Hawaii; Rota, Spain; and Kadena Air Base, Ryuku Islands.

A situation such as a systems failure forcing landing on the first day of flight would mean landing at Edwards at the end of the fifth orbit.

#### ORBITER COLUMBIA'S MAIDEN FLIGHT

##### (Configuration)

When fully fitted out for operational flights (STS-5 and on), Columbia's middeck will house more creature comforts for the crew than the somewhat spartan accommodations of the first orbital test flight. For example, no sleeping bags have been stowed nor bunks installed aboard Columbia. Young and Crippen will sleep strapped into the flight deck ejection seats in their flight overalls. Sleep kits, with ear plugs and eye covers, have been provided for making the two sleep periods more comfortable.

Columbia and the other Orbiters joining the fleet will be fitted with airliner-type galleys for meal preparation. On this first flight, however, a carry-on electrical food warmer will heat meals stowed in middeck lockers. Orbiters will not have freezers or refrigerators.

Until ejection seats are removed from Columbia after STS-4, crews will wear modified USAF high-altitude pressure suits during launch and entry. Two-piece treated-cotton inflight coveralls will be worn during orbital flight. Shuttle spacesuits, or extra-vehicular mobility units (EMU), are aboard STS-1 for a contingency spacewalk.

Should the need for a contingency spacewalk arise, such as failure of the mechanical actuators to close the payload bay doors, cabin pressure would be reduced from 14.5 pounds per square inch (21/79-percent oxygen/nitrogen mix) to 9 psi (28/72-percent oxygen/nitrogen).

Crippen would go out through the airlock to manually close the payload bay doors after some 14 hours of pre-breathing at the reduced pressure and at the higher oxygen level to purge suspended nitrogen from the blood stream. Lowering Orbiter cabin pressure to 9 psi eliminates the need for Crippen to pre-breathe on an umbilical or on a portable oxygen system and thereby shortens an EVA "work day" by two hours. Moreover, the procedure also pre-breathes Young, should he have to suit up and give Crippen a hand with the payload bay doors.



As a hedge against the payload doors failure to open after Columbia is in orbit, additional potable water tanks have been loaded for the flash evaporators. The flash evaporators transfer metabolic and systems heat from Freon loops to water when the payload doors are closed. Space radiators are attached to the inside of the payload bay doors for heat rejection when the doors are open. (See page 4-21 of the Space Shuttle News Reference.)

If the payload bay doors fail to open during the second orbit, Columbia would be brought down to a landing at Edwards at the end of the fifth orbit. Failure of the payload bay doors to close would call for cabin depressurization to 9 psi and Crippen's spacewalk 14 hours later to unjam the doors.

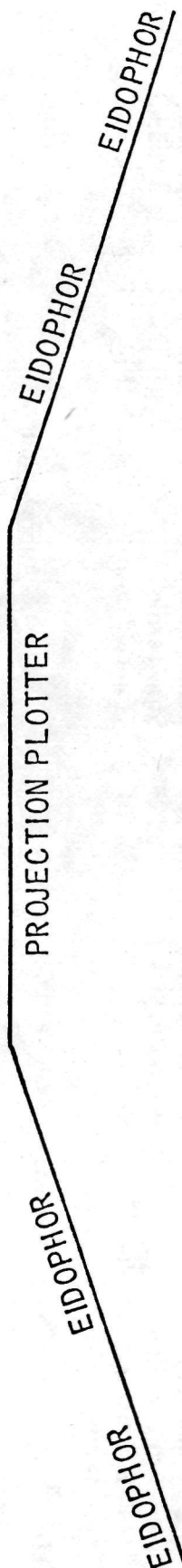
Except for developmental flight instrumentation and the aerodynamic coefficient identification package, Columbia's payload bay will be bare.

Although Mission Control Center-Houston is described in the News Reference as it will be for STS mature operations, for orbital flight tests MCC-H will appear much the same as it did for Apollo and Skylab. The second-floor Mission Operations Control Room (MOCR) has been modified for early Space Shuttle flights.

#### Huntsville Operations Support Center

During the STS-1 countdown, launch and powered flight toward orbit, design experts at the Marshall Space Flight Center, Huntsville, Ala., will monitor real-time data from the vehicle to provide a trouble shooting capability on Marshall-developed Shuttle hardware. Their purpose will be to assist in the early detection of potential problems and to help evaluate and solve them. This pool of propulsion system design experts, consisting of Marshall engineers, project management officials and contractor personnel, will be assembled at the Marshall Center's Huntsville Operations Support Center. Marshall is responsible for development of the Space Shuttle main engines, external tank and solid rocket boosters.

# MCC MISSIONS OPERATIONS CONTROL ROOM (MOCR) POSITIONS ROOM 231



GRND RESOURCES &  
NETWORK MANAGER  
(GC)

FLIGHT  
DYNAMICS  
OFFICER  
(FIDO)

GUIDANCE  
OFFICER  
(GUIDANCE)

DATA PROCESSING  
SYSTEM ENGINEER  
(DPS)

COMPUTER  
COMMAND  
(COMMAND)

FLIGHT  
PHYSICIAN  
(SURGEON)

BOOSTER  
SYSTEM ENGR  
(BOOSTER)

PROPULSION  
SYSTEMS ENGR  
(PROP)

GUIDANCE, NAVIGATION  
& CONTROL SYS ENGR  
(GNC)

ELECT PWR,  
INSTRU & LIGHT  
SYSTEMS ENGR  
(EGIL)

ENV, CONSUM &  
MECH SYSTEMS  
ENGR  
(EECOM)

INTEGRATED COMM  
SYSTEMS ENGR  
(INCO)

OPERATIONS  
INTEGRATION  
OFFICER  
(OIO)

FLIGHT  
DIRECTOR  
(FLIGHT)

SPACECRAFT  
COMMUNICATOR  
(CAPCOM)

FLIGHT  
ACTIVITIES  
OFFICER  
(FAO)

PAYLOADS  
OFFICER  
(PAYLOAD)

PUBLIC AFFAIRS  
OFFICER  
(PAO)

FLIGHT OPERATIONS  
MGR

PROGRAM MANAGER

NASA HEADQUARTERS MGR  
DOD MGR

# SHUTTLE - STANDARD OFT MENU

MEAL DAY 1<sup>1</sup>, 5

DAY 2, 6

DAY 3, 7

DAY 4, 8

| A | Peaches<br>Beef Pattie<br>Scrambled Eggs<br>Bran Flakes<br>Cocoa<br>Orange Drink   | (T)<br>(R)<br>(R)<br>(R)<br>(B)<br>(B)           | Applesauce<br>Dried Beef<br>Granola<br>Breakfast Roll<br>Choc. Inst. Brkfst<br>Orange-Grapefruit Drk         | (T)<br>(NF)<br>(R)<br>(I)(NF)<br>(B)<br>(B)    | Dried Peaches<br>Sausage<br>Scrambled Eggs<br>Cornflakes<br>Cocoa<br>Orange-Pineapple Drink  | (IM)<br>(R)<br>(R)<br>(R)<br>(B)<br>(B)                    | Dried Apricots<br>Breakfast Roll<br>Granola w/Blueberries<br>Vanilla Inst. Brkfst<br>Grapefruit Drink          | (IM)<br>(I)(NF)<br>(R)<br>(B)<br>(B)     |
|---|--|--|--|--|--|--|--|--|
| B | Frankfurters<br>Turkey Tetrazzini<br>Bread (2X)<br>Bananas<br>Almond Crunch Bar<br>Apple Drink (2X)                        | (T)<br>(R)<br>(I)(NF)<br>(FD)<br>(NF)<br>(B)     | Corned Beef<br>Asparagus<br>Bread (2X)<br>Pears<br>Peanuts<br>Lemonade (2X)                                  | (T)(I)<br>(R)<br>(I)(NF)<br>(T)<br>(NF)<br>(B) | Ham<br>Cheese Spread<br>Bread (2X)<br>Gr. Beans & Broccoli<br>Crushed Pineapple<br>Shortbread Cookies<br>Cashews<br>Tea w/Lemon & Sugar (2X) | (T)<br>(T)<br>(I)(NF)<br>(R)<br>(T)<br>(NF)<br>(NF)<br>(B) | Ground Beef w/<br>Pickle Sauce<br>Noodles & Chicken<br>Stewed Tomatoes<br>Pears<br>Almonds<br>Strawberry Drink | (T)<br>(R)<br>(T)<br>(FD)<br>(NF)<br>(B) |
| C | Shrimp Cocktail<br>Beef Steak<br>Rice Pilaf<br>Broccoli au Gratin<br>Fruit Cocktail<br>Butterscotch pudding<br>Grape Drink | (R)<br>(T)(I)<br>(R)<br>(R)<br>(T)<br>(T)<br>(B) | Beef w/BBQ Sauce<br>Cauliflower w/Cheese<br>Gr. Beans w/Mushrooms<br>Lemon Pudding<br>Pecan Cookies<br>Cocoa | (T)<br>(R)<br>(R)<br>(T)<br>(NF)<br>(B)        | Cr. Mushroom Soup<br>Smoked Turkey<br>Mixed Italian Vegetables<br>Vanilla Pudding<br>Strawberries<br>Tropical Punch                          | (R)<br>(T)(IM)<br>(R)<br>(T)<br>(R)<br>(B)                 | Tuna<br>Macaroni & Cheese<br>Peas w/Butter Sauce<br>Peach Ambrosia<br>Chocolate Pudding<br>Lemonade            | (T)<br>(R)<br>(R)<br>(R)<br>(T)<br>(B)   |

NOTE: <sup>1</sup> Day 1 (launch day) consists of Meal B and C only

## Abbreviations

T --- Thermostabilized  
IM --- Intermediate Moisture  
R --- Rehydratable

I --- Irradiated  
FD --- Freeze-Dried  
NF --- Natural Form  
B --- Beverage (Rehydratable)



SPACEFLIGHT TRACKING AND DATA NETWORK (STDN)

The Spaceflight Tracking and Data Network (STDN) is a highly complex NASA worldwide system that provides reliable, continuous and instantaneous communications with the Space Shuttle Orbiter and crew. The network is maintained and operated by NASA Goddard Space Flight Center, Greenbelt, Md.

The network for the Shuttle Orbital Flight Test Program consists of 18 ground stations equipped with 4.26-, 9.14-, 12.19- and 25.9-m (14-, 30-, 40- and 85-ft.) S-band antenna systems and C-band radar systems, the NASA Communications System (NASCOM) augmented by 15 Department of Defense geographical locations providing C-band support and one Defense 18.3 m (60-ft.) S-band antenna system. In addition, there are six major computing interfaces located at the Goddard Space Flight Center: Network Operations Control Center (NOCC at Goddard; Western Space and Missile Center, Vandenberg Air Force Base; Air Force Satellite Control Facility, Sunnyvale, Calif.; White Sands Missile Range, N.M.; and Eastern Space and Missile Center, Fla., providing real-time network computational support.

The network has support agreements with the governments of Australia, Spain, Senegal, Botswana, Ecuador, Chile, United Kingdom and Bermuda to provide NASA tracking stations support to the Space Transportation System program.

Should the Johnson Space Center Mission Control Center be seriously impaired for an extended time, the Network Operations Control Center at Goddard becomes an emergency mission control center.

The Merritt Island Florida S-band station provides the appropriate data to the Launch Control Center at Kennedy and the Mission Control Center at Johnson during prelaunch testing and the terminal countdown. During the first minutes of launch and during the ascent phase, the Merritt Island and Ponce de Leon, Fla., S-band and Bermuda S-band stations, as well as the C-band stations located at Bermuda; Wallops Island, Va.; Grand Bahamas; Grand Turk; Antigua; Cape Canaveral; and Patrick Air Force Base, Fla., will provide tracking data, both high speed and low speed, to the Kennedy and Johnson Control Centers.

The Madrid, Spain; Indian Ocean Station Seychelles; Ororua and Yarragadee, Australia; and Guam stations provide critical support to the orbital maneuvering systems burns. During the orbital phase all the S-band and C-band stations that see the Space Shuttle Orbiter at 30 degrees above the horizon will support and provide appropriate tracking, telemetry, air-ground and command support to the Johnson Mission Control Center through Goddard.

During the nominal reentry and landing phase planned for Edwards Air Force Base, Calif., the Goldstone and Buckhorn, Calif., S-band stations and C-band stations at the Pacific Missile Test Center, Vandenberg Air Force Base, Edwards Air Force Base and Dryden Flight Research Center will provide tracking, telemetry, command and air-ground support to the Orbiter and send appropriate data to the Johnson and Kennedy Control Centers.

#### NASA Communications Network (NASCOM)

The tracking network is linked together by the NASA Communications Network from which all information flows to and from Mission Control Center, Johnson.

The communications network consists of more than 2 million circuit miles of diversely routed communications channels. It uses domestic and international communications satellites, submarine cable and terrestrial landlines and microwave radio systems to interconnect the myriad of tracking stations, launch and orbital control centers and other supporting locations.

The hub of the communications network is the main switching center at Goddard. From Goddard, personnel direct overall network operation including those at supporting NASCOM switching centers in Madrid, Spain; Canberra, Australia; and Jet Propulsion Laboratory, Pasadena, Calif. Additionally, support activities are provided by Air Force communications centers at Cape Canaveral, Fla., and Vandenberg Air Force Base, Calif.

A key change in the communications network has been implementation of two simultaneous air-ground S-band voice circuits in addition to UHF radio capability. In previous Apollo missions only one S-band circuit was provided. Telemetry data circuitry from tracking stations was increased in size to handle 128,000 bits per second (128 kilobits per second) in real time versus the 14-21 kbps in previous programs. Correspondingly, the command data circuit to a station was increased from 7.2 kbps to a 56 kbps capability.

During previous manned program support, use of communications satellites was limited to those connecting the United States with foreign locations (Intelsat system). Since then, domestic communications satellites have become available and they now play a key role in extending voice, data and television signals from key locations and stations in the United States. Additionally, they provide for extending data between Goddard and foreign locations as well as between Goddard and Johnson.

#### Network Systems Support

At fraction-of-a-second intervals, the network's data processing systems, with Johnson's Mission Control Center as the focal point, "talk" to each other or to the spacecraft.



High-speed computers at the remote site relay commands at a 56-kilobit data rate on such matters as control of cabin pressure, orbital guidance commands or "go/no-go" indications to perform certain functions. In addition, they provide digital voice uplink and downlink from the stations to the Orbiter.

The command and air-ground voice is mixed together at the remote station and uplinked to the Orbiter at a 72- or 32-kilobit rate.

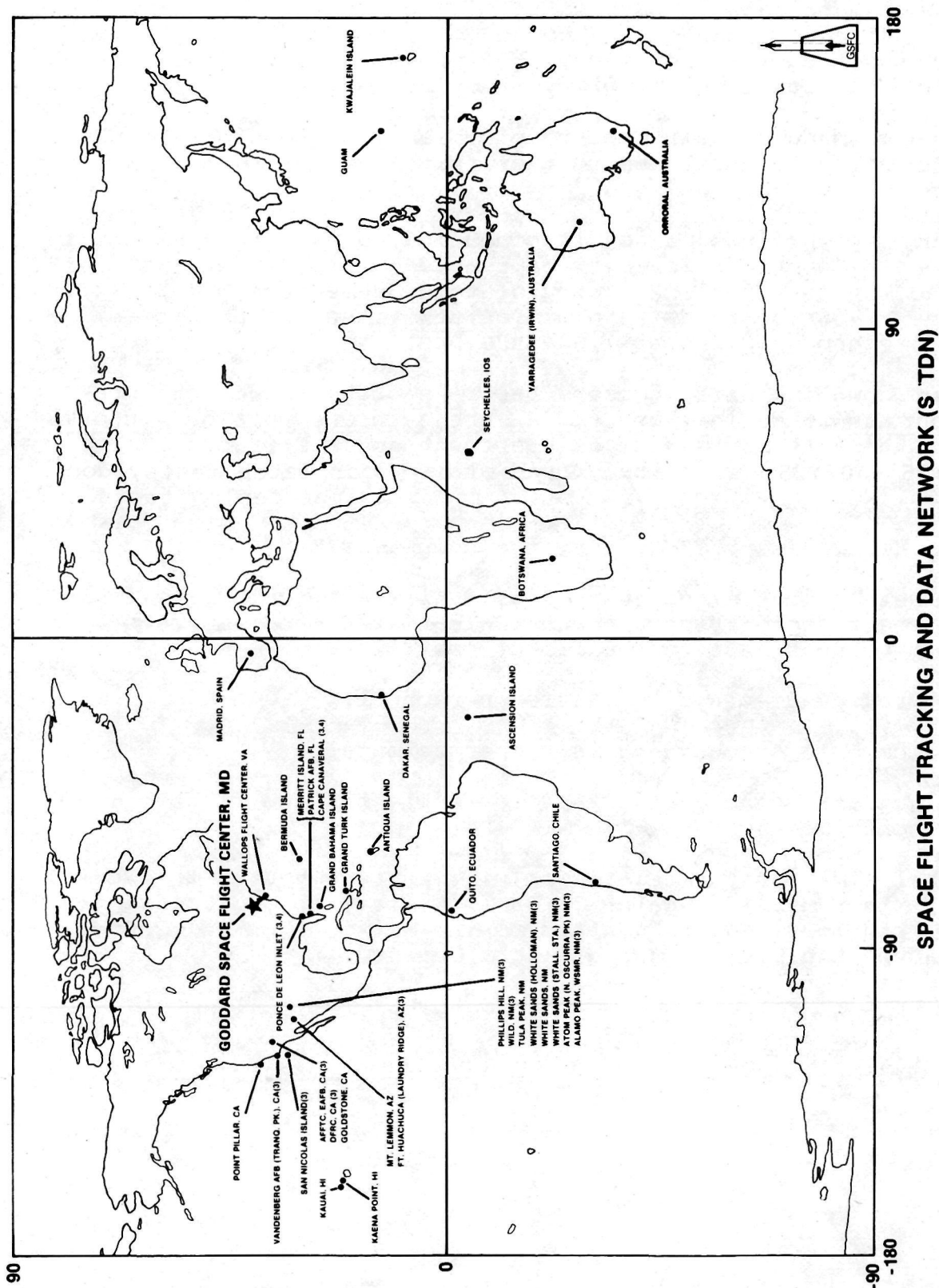
Such uplink information is communicated at a rate of about 4,800 bps. Communication between remote ground sites, via high-speed communications links, occurs at the same rate on a 56-kilobit line. Houston reads information, two channels at a time, from these ground sites at 1,544,000 bps.

For downlink data, sensors built into the spacecraft continually sample cabin temperature, pressure and physical information on the astronauts such as heartbeat and respiration. These data are transmitted to the ground stations at 96, 128 or 192 kilobits.

At Mission Control Center, the computers:

- Detect and select changes or deviations, compare with their stored programs and indicate the problem areas or pertinent data to the flight controllers;
- Provide displays to mission personnel;
- Assemble output data in proper formats;
- Log data on magnetic tape for reply for the flight controllers.

Real time orbital television will be received by the Merritt Island, Fla.; Madrid, Spain; Ororol, Australia; and Goldstone, Calif., stations and transmitted to the Mission Control Center, Houston via the Goddard Space Flight Center.



PHOTOGRAPHY AND TELEVISION SCHEDULES

Except where noted as VTR (video tape recorder), television from Columbia during STS-1 will be fed live to the tracking stations being overflowed at the time. Two closed-circuit color television cameras in the spacecraft cabin will be managed from Mission Control by ground commands once the cameras are activated by the crew. There are no plans to "dump" scenes from 30-minute VTR cassettes recorded when Columbia is not in view of a tracking station.

STS-1 Television Schedule

| <u>Mission Elapsed Time</u><br><u>Day/Hours:Minutes</u> | <u>Subject</u>  |
|---|---|
| 00/01:25 - 02:25  | Payload bay door latch tests, door tests and radiator deploy tests during first payload bay door operations (VTR) |
| 00/01:36 - 01:56  | Payload bay door opening and closing  |
| 00/09:20 - 09:25  | Young reports status of flight  |
| 01/01:00 - 01:20  | Checkout television system with artificial lighting (VTR)   |
| 01/00:01 - 00:23  | Flight control system checkout, forward flight deck   |
| 01/03:02 - 03:08  | Crippen prepares meal on Columbia middeck   |
| 01/10:49 - 10:54  | Crippen replaces carbon dioxide absorber on middeck   |
| 02/01:31 - 01:41  | MCC remotely operates payload bay television  |
| 02/02:32 - 03:03  | Payload bay door closed for deorbit   |

Young and Crippen will document the flight in 16mm motion picture, and 35mm and 70mm still picture formats. In addition to photo targets of opportunity, the crew will photograph the following subjects during the flight:

Photography Schedule

| <u>Day/Hr:Min</u>        | <u>Camera</u> | <u>Subject</u>  |
|--------------------------|---------------|---|
| 00/00:00:30              | 16mm          | Launch  |
| 00/01:45                 | 70mm          | Payload bay   |
| 00/12:05                 | 16mm          | Replacement of carbon dioxide absorber on middeck                                     |
| 01/08:31                 | 35mm          | Food warmer activation and food preparation on middeck                                |
| 01/09:00                 | 16mm          | Out-the-window view of Earth limb while Young checks out reaction control thrusters   |
| 01/09:00                 | 70mm          | Out-the-window view of Earth limb   |
| 01/09:08                 | 35mm          | Cockpit operations during reaction control system tests                               |
| 01/11:18                 | 35mm          | Forward flight deck during automatic maneuver for inertial measurement unit alignment |
| 01/12:30                 | 16mm          | Personal hygiene on middeck   |
| 25,900 m<br>(85,000 ft.) | 16mm          | Landing   |



BIOGRAPHICAL DATA

NAME: John W. Young, STS-1 Commander

BIRTHPLACE AND DATE: Born in San Francisco, Calif., on Sept. 24, 1930. His parents, Mr. and Mrs. William H. Young, reside in Orlando, Fla.

PHYSICAL DESCRIPTION: Brown hair; green eyes; height: 5 ft., 9 in.; weight: 165 lb.

EDUCATION: Graduated from Orlando High School, Fla.; received a bachelor's degree in aeronautical engineering with highest honors from the Georgia Institute of Technology in 1952.

MARITAL STATUS: Married to the former Susy Feldman of St. Louis, Mo.

CHILDREN: Sandy, April 30, 1957; and John, Jan. 17, 1959.

RECREATIONAL INTERESTS: Running.

ORGANIZATIONS: Fellow of the American Astronautical Society (AAS) and the Society of Experimental Test Pilots (SETP); and associate fellow of the American Institute of Aeronautics and Astronautics (AIAA).

SPECIAL HONORS: Awarded two NASA Distinguished Service Medals, two NASA Exceptional Service Medals, the Johnson Space Center Certificate of Commendation (1970) and Special Achievement Award (1978), the Navy Astronaut Wings, the SETP Iven C. Kincheloe Award (1972), the AAS Flight Achievement Award (1972), the AIAA Haley Astronautics Award (1973).

EXPERIENCE: Upon graduation from Georgia Tech, Young entered the U.S. Navy. After serving on a West Coast destroyer for one year, he was sent to flight training in props, jets and helicopters. He was then assigned to Fighter Squadron 103 for four years flying "Cougars" and "Crusaders."

After test pilot training at the U.S. Navy Test Pilot School in 1959, he was assigned to the Naval Air Test Center for three years. His test projects included evaluations of the Crusader and "Phantom" fighter weapons systems. In 1962, he set world time-to-climb records to 3,000- and 25,000-meter altitudes in the Phantom. Prior to reporting to NASA, he was maintenance officer of Phantom Fighter Squadron 143. Young retired from the Navy in September 1976, after completing almost 25 years of active military service.

He has logged more than 8,000 hours flying time, including 533 hours and 33 minutes in four space flights.

**NASA EXPERIENCE:** Young was selected as an astronaut by NASA in September 1962.

He served as pilot with command pilot Gus Grissom on the first manned Gemini flight on March 23, 1965, a three-orbit mission, during which the crew accomplished the first manned spacecraft orbital trajectory modifications and lifting reentry.

On July 18, 1966, Young was the command pilot on the Gemini 10 mission, with Michael Collins as pilot. They rendezvoused and docked with the Agena target vehicle, then, by igniting the Agena main engine, propelled the docked combination to a record-setting altitude of 475 miles. Then a second rendezvous was performed on another Agena which had been placed in orbit three months earlier, and while Young flew formation beside the Agena, Collins did an extravehicular activity to recover a micrometeorite detector from the Agena.

He was the command module pilot for Apollo 10, May 18-26, 1969, the lunar orbital qualification test of the Apollo lunar module with Thomas P. Stafford, spacecraft commander, and Eugene Cernan, lunar module pilot. Apollo 10 verified the performance of the docked spacecraft configuration during translunar coast and lunar orbit insertion, and verified lunar orbital performance during lunar module separation and descent to within 8 nautical miles of the lunar surface, and lunar rendezvous.

His fourth space flight was as spacecraft commander of Apollo 16, April 16-27, 1972, with Thomas K. Mattingly II, command module pilot, and Charles M. Duke Jr., lunar module pilot. The Apollo 16 lunar mission inspected, surveyed and sampled materials and investigated surface features in the lunar highlands. Young and Duke spent over 71 hours on the Cayley Plains at Descartes. They logged 20 hours in extra-vehicular activities activating scientific equipment, collecting about 200 pounds of rock and soil samples and driving the lunar rover for 27 km on the rugged lunar terrain. On the way back to Earth, Apollo 16 accomplished an Apollo transearth coast extravehicular activity of more than one hour duration when Mattingly retrieved the scientific film cassettes from the scientific instruments compartment of the command and service module.

Young was also backup pilot of Gemini 6, backup command module pilot of Apollo 7 and backup spacecraft commander for Apollo 13 and 17.

In January 1973, he was assigned responsibility for the Space Shuttle Branch of the Astronaut Office which provided operational and engineering astronaut support for the Space Shuttle Program.

CURRENT ASSIGNMENT: Young was named Chief of the Astronaut Office in January 1975. In this assignment, he is responsible for the coordination, scheduling and control of astronaut activities. In March 1978, he was assigned as spacecraft commander of the Space Shuttle's first orbital flight test with Robert L. Crippen as pilot.

# # # # #



NAME: Robert L. Crippen (Captain, USN), pilot.

BIRTHPLACE AND DATE: Born in Beaumont, Texas, on Sept. 11, 1937.  
He grew up in Porter, Texas, where his mother, Mrs. Herbert W. Crippen, now resides.

PHYSICAL DESCRIPTION: Brown hair; brown eyes; height: 5 ft.,  
10 in.; weight: 160 lb.

EDUCATION: Graduated from New Caney High School, Texas; received  
a bachelor's degree in aerospace engineering from the University of Texas in 1960.

MARITAL STATUS: Married to the former Virginia E. Hill. Her  
parents, Mr. and Mrs. James D. Hill, reside in Corpus Christi, Texas.

CHILDREN: Ellen Marie, June 14, 1962; Susan Lynn, Dec. 24, 1964;  
Linda Ruth, May 10, 1967.

SPECIAL HONORS: Awarded the NASA Exceptional Service Medal and  
the Johnson Space Center Group Achievement Award (1972).

EXPERIENCE: Crippen received his commission through the Navy's  
Aviation Officer Program at Pensacola, Fla., which he entered after graduation from the University of Texas. He continued his flight training at Whiting Field, Fla., and went from there to Chase Field in Beeville, Texas, where he received his wings.

From June 1962 to November 1964, he was assigned to Fleet Squadron VA-72 -- completing two-and-one-half years of duty as an attack pilot aboard the aircraft carrier USS INDEPENDENCE. He later attended the U.S. Air Force Aerospace Research Pilot School at Edwards Air Force Base, Calif., and, upon graduation, remained there as an instructor until his selection in October 1966 to the USAF Manned Orbiting Laboratory Program. Crippen was among the second group of aerospace research pilots to be assigned to the MOL Program.



He has logged more than 4,275 hours flying time, which include more than 4,090 hours in jet aircraft.

**NASA EXPERIENCE:** Crippen became a NASA astronaut in September 1969. He was a crew member on the highly successful Skylab Medical Experiments Altitude Test (SMET) -- a 56-day simulation of the Skylab mission, enabling crewmen to collect medical experiments baseline data and evaluate equipment, operations and procedures.

Crippen was a member of the astronaut support crew for the Skylab 2, 3 and 4 missions, and he served in this same capacity for the Apollo Soyuz Test Project (ASTP) mission which was completed successfully in July 1975.

**CURRENT ASSIGNMENT:** Crippen has been designated pilot for one of the four two-man crews selected to fly Space Shuttle orbital flight tests and, with John W. Young, will fly STS-1 in 1981.

# # # # #



NASA-S-80-40384

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Lynwood C. Dunseith

Director of Data Systems and  
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| Gerald D. Griffin  | Deputy Director                        |
| Raymond L. Clark   | Associate Director for STS Development |
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| George F. Page     | Director, Shuttle Operations           |

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| Thomas J. Lee         | Deputy Director                                       |
| Robert E. Lindstrom   | Manager, MSFC Shuttle Projects Office                 |
| James E. Kingsbury    | Director, Science and Engineering Directorate         |
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| George B. Hardy       | Manager, Solid Rocket Booster Project                 |
| James R. Thompson Jr. | Manager, Space Shuttle Main Engine Project            |
| James M. Sisson       | Manager, Engineering and Major Test Management Office |

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tions Network

Donald D. Wilson

Assistant Chief, NASA Communica-  
tions Network

Daniel Spintman

Chief, Network Operations  
Division

ABBREVIATIONS/ACRONYMS

|       |   |
|-------|---|
| AA    | Accelerometer Assembly, Angular Accelerometer   |
| A/A   | Air-to-Air                                      |
| ACCEL | Accelerometer                                   |
| ACCU  | Audio Center Control Unit                       |
| ACIP  | Aerodynamic Coefficients Identification Package |
| ACN   | Ascension Island (STDN site)                    |
| ADI   | Attitude Directional Indicator                  |
| AGO   | Santiago, Chile (STDN site)                     |
| ANG   | Angle   |
| ANT   | Antenna   |
| AOA   | Abort Once Around                               |
| AOS   | Acquisition of Signal                           |
| APU   | Auxiliary Power Unit                            |
| ATO   | Abort to Orbit                                  |
| AUD   | Audio   |
| AUTO  | Automatic                                       |
| BDA   | Bermuda Island (STDN site)                      |
| BOT   | Botswana (STDN site)                            |
| BRT   | Bright  |
| BUC   | Buckhorn, Calif. (STDN site)                    |
| CAL   | Calibration                                     |
| CAMR  | Camera  |
| CCTV  | Close Circuit Television                        |
| CCU   | Crewman Communications Umbilical                |
| CDR   | Commander                                       |
| CNSL  | Console   |

|        |  |
|--------|--|
| CNTRLR | Controller                                 |
| C/O    | Checkout                                   |
| COAS   | Crewman Optical Alignment Sight            |
| CONT   | Continuous                                 |
| CRT    | Cathode Ray Tube                           |
| CTR    | Center                                     |
| C/W    | Caution and Warning                        |
| DAP    | Digital Auto Pilot                         |
| DB     | Deadband                                   |
| DFI    | Development Flight Instrumentation         |
| DISC   | Discrete                                   |
| DKR    | Dakar, Senegal (STDN site)                 |
| DTO    | Detailed Test Objective                    |
| ECLS   | Environmental Control Life Support         |
| EDW    | Edwards AFB, Calif. (Deorb OPT site)       |
| EES    | Emergency Ejection Suits                   |
| EET    | Entry Elapsed Time                         |
| EI     | Entry/Interface                            |
| ET     | External Tank                              |
| FCS    | Flight Control System                      |
| FDF    | Flight Data File                           |
| FM     | Frequency Modulation                       |
| FRD    | Flight Requirements Document               |
| FSO    | Functional Supplementary Objective         |
| FTO    | Functional Test Objective                  |
| GDS    | Goldstone, Calif. (STDN site, 1st antenna) |
| GDX    | Goldstone, Calif. (STDN site, 2nd antenna) |



|         |   |
|---------|---|
| GLRSHLD | Glareshield                                 |
| GMT     | Greenwich Mean Time                         |
| GNC     | Guidance Navigation and Control             |
| GPC     | General Purpose Computer                    |
| GWM     | Guam Island, U.S. (STDN site)               |
| H2      | Hawaii (Kauai, STDN site)                   |
| HIC     | Hickam AFB, Hawaii (Deorb OPT site)         |
| HTR     | Heater                                      |
| IECM    | Induced Environmental Contamination Monitor |
| IMU     | Inertial Measurement Unit                   |
| INRTL   | Inertial                                    |
| IOS     | Indian Ocean (STDN site)                    |
| ITS     | Interim Teleprinter System                  |
| KAD     | Kadena AB, Ryuku Islands (Deorb OPT site)   |
| KSC     | Kennedy Space Center, Fla. (Deorb OPT site) |
| L       | Left  |
| LH2     | Liquid Hydrogen                             |
| LON     | Longitude                                   |
| LOS     | Loss of Signal                              |
| LOX     | Liquid Oxygen                               |
| LTG     | Lighting                                    |
| LVLH    | Local Vertical Local Horizontal             |
| MAD     | Madrid, Spain (STDN site, 1st antenna)      |
| MAN     | Manual                                      |
| MAX     | Madrid, Spain (STDN site, 2nd antenna)      |
| MECO    | Main Engine Cutoff                          |
| MET     | Mission Elapsed Time                        |



|      |   |
|------|---|
| MIL  | Merritt Island, Fla. (STDN site, 1st antenna) |
| MLX  | Merritt Island, Fla. (STDN site, 2nd antenna) |
| MNVR | Maneuver                                      |
| NOR  | Northrup FLT Strip, N.M. (Deorb OPT site)     |
| NOZ  | Nozzle  |
| O2   | Oxygen  |
| OFI  | Operational Flight Instrumentation            |
| OI   | Operational Instrumentation                   |
| OMS  | Orbital Maneuvering System                    |
| OPR  | Operator                                      |
| OPS  | Operations, Operational Sequence              |
| ORB  | Orbiter                                       |
| ORR  | Orroral Valley, Australia (STDN site)         |
| OVHD | Overhead                                      |
| PA   | Power Amplifier                               |
| PCM  | Pulse-Code Modulation                         |
| PL   | Payload                                       |
| PLBD | Payload Bay Doors                             |
| PLT  | Pilot   |
| PM   | Phase Modulation                              |
| PMC  | Private Medical Communication                 |
| PNL  | Panel   |
| POS  | Position                                      |
| PRO  | Proceed                                       |
| PTC  | Passive Thermal Control                       |
| PWR  | Power   |
| QTY  | Quantity                                      |

|          |  |
|----------|--|
| QUI      | Quito, Ecuador (STDN site)             |
| R        | Right                                  |
| RCDR     | Recorder                               |
| RCS      | Reaction Control System                |
| REF      | Reference                              |
| REFSMMAT | Reference Stable Member Matrix         |
| RELMAT   | Relative Matrix                        |
| RGA      | Rate Gyro Assembly                     |
| ROS      | Regulated Oxygen System                |
| ROT      | Rota, Spain (Deorb OPT site), Rotation |
| RT       | Rotation Discrete Rate                 |
| SAA      | South Atlantic Anomaly                 |
| SEL      | Select                                 |
| SEP      | Separation                             |
| SGLS     | Space Ground Link System               |
| SPKR     | Speaker                                |
| SPLY     | Supply                                 |
| STBY     | Standby                                |
| SV       | State Vector                           |
| SYS      | Systems                                |
| TB       | Talkback                               |
| TDRS     | Tracking and Data Relay Satellite      |
| TK       | Tank                                   |
| T/L      | Timeline                               |
| TRKR     | Tracker                                |
| TUL      | Tula Peak, N.M. (STDN site)            |
| TV       | Television                             |

|       |  |
|-------|--|
| UHF   | Ultra High Frequency                           |
| VAC   | Vacuum   |
| VLV   | Valve  |
| VTR   | Video Tape Recorder                            |
| WCS   | Waste Collection System                        |
| WIN   | Irwin, Australia (STDN site)                   |
| WMC   | Waste Management Compartment                   |
| XFER  | Transfer                                       |
| X-POP | X Body Axis Perpendicular to Orbit Plane       |
| Y-POP | Y Body Axis Perpendicular to Orbit Plane       |
| -ZLV  | -Z Local Vertical (-Z Body Axis Towards Earth) |

-end-